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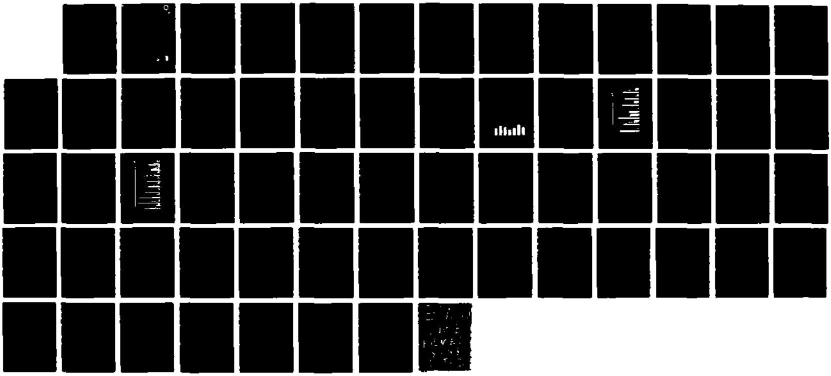

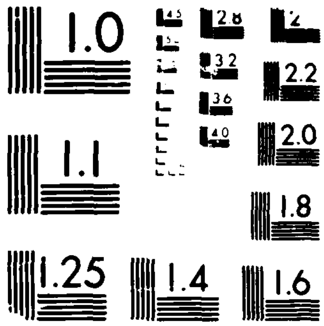

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Building Decision Support Systems: The Bases and Stations Information System (BASIS)

NPRDC TR 88-9 April 1988

BUILDING DECISION SUPPORT SYSTEMS: THE BASES AND STATIONS INFORMATION SYSTEM (BASIS)

Amy L. Culbertson
Bela Feher
Melvyn C. Moy
Henry Simpson
Steve Ferrier

Approved by Richard C. Sorenson

Released by
B.E. Bacon
Captain, U.S. Navy
Commanding Officer

and

James S. McMichael
Technical Director

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Navy Personnel Research and Development Center
San Diego, California 92152-6800

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As information systems become more common in business and as sophistication of computer technology grows, managers are requesting computer-based tools to assist them in more complex ways with decision making. Computer systems designed to address this need are usually referred to as decision support systems (DSS). DSS developers need to address the following areas: (1) the kinds of computer tools that would best assist managers with decision making, and (2) the optimal method to use in designing a DSS. This report presents a user-oriented model of DSS development and applies this model to the design of a DSS for Navy bases and stations, in conjunction with the Bases and Stations Information System (BASIS). The model provided a useful framework for guiding DSS design, and may be applied to other DSS development efforts. Analysis of the data shows department heads of Navy bases and stations to be a reasonably homogeneous group of target users, who could benefit greatly from a DDS that provides generic tools usable across a wide range of managerial problems for data display, manipulation, and analysis.

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FOREWORD

This work was sponsored by the Deputy Chief of Naval Operations (CNO) (OP-01B, Manpower, Personnel, and Training) through Program Element 63701: Human Factors Advanced Development. It provided support for the development of the Bases and Stations Information System (BASIS), which is sponsored by the Information Systems Division of the Command and Control Office of CNO (OP-945), and managed by the Naval Data Automation Command (NAVDAC).

This is the second report addressing the development of a command-level decision support system workstation for BASIS. The methodology and results presented here are intended to assist BASIS developers in meeting their goals of providing a user-friendly system that employs current technology and state-of-the-art equipment. The development methodology discussed here is applicable to the development of decision support systems for other computer-based information systems. The preparation of this report was supported by funding from NAVDAC.

Appreciation is expressed to all department heads and their representatives who participated in the task analysis and interview.

B.E. BACON
Captain, U.S. Navy
Commanding Officer

JAMES S. McMICHAEL
Technical Director

SUMMARY

Problem

Effective management of complex operations such as Navy bases and stations requires maintenance of and ready access to massive amounts of information. The Bases and Stations Information System (BASIS) is a computer-based network currently under development to fulfill the command staff's need for timely and accurate information concerning base/station activities. BASIS developers are striving to deliver a system that interfaces with the several standard management information systems (MIS) already mandated by various functional area sponsors. BASIS is to be a major information trunkline that allows users to share information. All this must occur in a "user-friendly" environment in which the operation of the system is easy to learn, easy to use, and powerful enough to meet a significant portion of the user's demands for information.

This research effort focuses on an important component of BASIS, namely, the methods by which decision support capabilities for base and station command staffs ought to be developed. Such methods, if successful, should apply to a wide range of information systems for relatively unsophisticated computer operators who require the aid of automated systems for a broad range of decision making.

Purpose

The primary purpose of the overall effort is to provide decision support capabilities through BASIS to COs, XOs, and department heads of Navy bases and stations to aid them in fulfilling their job responsibilities. The goals of this phase of the project were to: (1) develop a methodology for designing decision support systems (DSS) for naval commanders, and (2) apply this methodology within the BASIS development effort.

Several subgoals were pursued: (1) to determine the scope of job responsibilities of department heads of Navy bases and stations, (2) to ascertain what important department head tasks would be the most amenable to computer-based decision support, (3) to assess the feasibility of providing department heads with generic decision support tools applicable to a wide range of problems and tasks, and (4) to identify department performance indicators that could be used in evaluating the impact of introducing an MIS or DSS into the organization.

DSS Development Approach

A user-oriented model of DSS development was synthesized for the present effort. This model consists of several discrete phases and steps: (1) decision task analysis, (2) selection of decisions to support, (3) descriptive analysis of decision processes, (4) conceptual definition of DSS, (5) development and integration of tools, and (6) test and revision. The first three steps comprise a requirements definition phase. The next two steps make up a design and development phase. The final phase encompasses operational test and revision of the DSS.

Approach

A computerized job task analysis relevant to department heads of Navy bases and stations was developed. Department heads rated the frequency and importance of 70 job tasks that could be computer aided in meeting their job responsibilities. Upon completion of the task analysis, department heads were asked several open-ended questions concerning computer equipment currently in their departments, present needs in terms of computer and decision support, and measures they use to gauge the performance of their departments.

Results

Eighty-two interviews were conducted at 16 Navy commands. Results from the job task analysis are presented. The job task frequency and importance ratings were compared across departments and across command types. Almost all department heads felt that computerization would improve the performance of their departments. The majority of the departments function with little or no computer automation. Even without exposure to the range of computer system capabilities, department heads were articulate in expressing the many needs that could be met by computer support. These are summarized. At the same time, department heads expressed concern about the development of competing systems, and the inability of systems to integrate with one another. Department performance indicators are also suggested for future evaluation efforts.

Discussion and Conclusions

Analysis of the task rating data shows department heads of Navy bases and stations to be a reasonably homogeneous group of target users who could benefit greatly from a DSS that provides generic tools for data display, manipulation, and analysis. In addition, the user-oriented model of DSS development described in this report provided a useful framework for guiding the initial efforts of DSS design. It is recommended that future development efforts adopt this or a similar methodology. This DSS development model ensures that the product is user-defined, user-specified, and user-evaluated. This type of involvement between developers and users throughout the design process is critical to system acceptance and success.

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INTRODUCTION

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Effective management of complex operations such as Navy bases and stations requires maintenance of and ready access to massive amounts of information. Because of the tremendous responsibilities and costs associated with the effective operation of Navy bases and stations, OP-945 is sponsoring an effort to provide managers with modern information management capabilities. The system under development is a computer-based network known as the Bases and Stations Information System (BASIS). It is designed to fulfill the command staff's need for timely and accurate information concerning base/station activities. BASIS will ultimately become a management information system (MIS) supporting at least 16 functional areas typical of base/station management and operation.

BASIS developers are striving to deliver a system that can interface with several standard information systems already in place (e.g., IDFMS, PASS/SDS, BEST). BASIS is to be a major information trunkline that allows users to access information from and transmit it to others who may be located elsewhere. The integrity of the source files and of security requirements for access to specific information is to be preserved. All this must occur in a "user-friendly" environment in which the operation of the system is easy to learn, easy to use, and powerful enough to meet a significant portion of the user's demands for information.

This effort focuses on an important component of BASIS, namely, the methods by which decision support capabilities for base and station command staffs ought to be developed. Such methods, if successful, should have applicability to a wide range of information systems that are used by relatively unsophisticated computer operators who require the aid of automated systems for decision making.

Purpose

The primary purpose of the overall effort is to provide decision support capabilities through BASIS to COs, XOs, and department heads of Navy bases and stations in fulfilling their job responsibilities. The goals of this phase of the project were to develop a method for designing decision support systems (DSSs) for naval base and station commanders and to implement this method within the BASIS development effort. In an earlier investigation (Stuster, Casey, Dick, & Moy, 1987), the needs of commanding officers (COs) and executive officers (XOs) of base and station commands were addressed. What remained was to determine decision support capabilities that could serve the next echelon of command--the department heads.

Several specific subgoals were pursued: (1) to determine the scope of job responsibilities of department heads of Navy bases and stations, (2) to ascertain what important department head tasks would be the most amenable to computer-based decision support, (3) to assess the feasibility of providing department heads with generic (broadly applicable) decision support tools, and (4) to identify department performance indicators that could be used in evaluating the impact of introducing an MIS or DSS into the organization.

BACKGROUND

DSS Design

Computer systems provided to managers are typically database management systems that may contain millions of data points, but provide only a limited means of querying the system for information. Most often there is only the capability of producing a number of marginally informative, standard reports. The breadth and formatting of the available information and reports are built in anticipation that the requester will be using the information in a well-defined manner. These systems are commonly referred to as management information systems (MIS), although the range of capabilities of MISs vary tremendously.

As information systems become more common in businesses and as computer technology becomes more sophisticated, managers are requesting more from systems than the mere display and printing of information. The users are becoming more sophisticated and creative about what is possible with the information they know is available in the computer. They are asking for more computer-based tools to assist them with the decision making process. They find standard reports are not sufficient for handling novel situations. The users want to be able to easily formulate *ad hoc* queries, to ask "what if" questions, and to massage information into a more useful form than homogeneous line printer reports. Systems designed to address these requirements are usually referred to as decision support systems (DSS).

Support for managers is the overriding concern in all DSS development efforts. Nevertheless, many DSSs have come under severe criticism by managers and have been discarded or ignored. Partow-Navid (1987) has outlined many reasons why DSSs fail, including: (1) incompatibility between DSS and end-user needs, (2) failure to define accurate, feasible goals, (3) the use of unrealistic or invalid models, (4) inadequate integration of tools handling aspects of a decision into a comprehensive model dealing with all parts of the decision, and (5) failure to secure user satisfaction through lack of user involvement in the development process. How one goes about designing a DSS that meets end-user needs and avoids these pitfalls has been strongly debated. Yet there is general agreement that the need for DSS is genuine.

Nutt (1986) separates the MIS/DSS development approach into two crucial steps: (1) identifying key activities of users and (2) specifying the information necessary to perform these activities. Although skepticism exists concerning the ability of users to assist in the development process, Nutt supports the idea that managers themselves can specify information requirements and assist in the development of an MIS/DSS.

King and Cleland (1975) outline several steps to follow in developing a DSS. They term their methodology "decision-oriented," and recommend that developers: (1) identify decision areas based on existing theory and interviews with appropriate managers, (2) define these decision areas, (3) develop a descriptive model of the system, (4) develop normative (ideal) and consensus models of the system, and (5) specify decision criteria and information requirements.

Stabell (1983) concurs with the decision-oriented approach. He states that there are two aspects of the decision process that must be understood. One is the substantive aspect, or the "what" of a decision. The other is the procedural aspect, or the "how" of a decision. Stabell concludes that DSS developers need "decisional imagination," or the ability to produce a working diagnosis of the what and how of a decision after limited exposure to a decision situation.

By virtue of their focus on decisions, many DSS developers acknowledge the need to integrate a decision analysis approach with their DSS development method. A decision model commonly applied to DSS development is that of Simon (1960), who discusses decision making in terms of three stages: (1) intelligence--searching the environment for conditions requiring a decision, (2) design--developing and analyzing possible courses of action, and (3) choice--selecting a course of action from those available. Scott-Morton (1971) also applies decision theories to the DSS arena, resulting in another analytic approach to DSS development. His approach recognizes the unique demands of semi-structured or unstructured decisions, and suggests this is where DSSs can have their most beneficial impact.

An issue that has received much attention in the DSS development area is that of individual differences and the impact of personal and cognitive styles on DSS design and usefulness. It may be necessary to build a flexible system that can accommodate a wide range of styles. This requirement is not always supported in research findings, however. Huber (1983) suggests that style may not be a critical moderating variable in DSS development. Nutt (1983) found that managers' information preferences were determined more by task conditions (such as decision stage and decision familiarity) than by cognitive styles or personal preferences of the individuals. Since task conditions are likely to be more homogeneous than the cognitive styles of individuals performing the tasks, this research suggests that the development process may be more manageable than was previously thought. Nonetheless, not all possible task conditions can be anticipated either.

Flexibility to meet the demands of novel and varied decision situations and users may be a key to DSS success. One implementation of a flexible DSS is described by Carlson (1983). He provides a DSS framework that accommodates a multitude of user styles and preferences. This framework consists of four components: (1) representations to assist in conceptualization; (2) operations for engaging in the decision processes of intelligence, design, and choice (Simon, 1960); (3) automated memory aids; and (4) user control over the system. A DSS that allows the user to engage in operations, access memory aids, and exert control over the system through a variety of alternative representations results in a truly flexible DSS.

Another issue implicit in the DSS design process is decision optimization. Most DSS developers argue that the primary objective of DSS development is to increase decision making effectiveness. Many DSS developers believe designers should provide optimal strategies for decision making within a DSS, rather than provide only the strategies that decision makers typically use. Optimization may be achieved by comparing and contrasting decision makers and decision processes within a specific context and choosing the best strategy (Stabell, 1983). Research in decision aiding has consistently demonstrated improvement in individual decision performance when aided by systems predicated on analytically optimal strategies. However, there is the possibility of rejection of the DSS by the user due to the "unnatural" process required by the optimum decision strategy. Furthermore, it might be expected that an optimal strategy may be specific to a narrow range of tasks, thus compromising the manager's need for broadly useful decision support.

An issue that demands attention throughout the DSS design and development process is that of the user-computer interface. How the end-user will access information and interact with the system is a critical component of DSS development. One design goal is for the query system to be flexible enough to accommodate users with a variety of objectives, experience, and personal styles.

> Some of the challenges in designing the interface for the decision maker are (1) to make him aware of the types of information that are available, (2) provide the decision maker with a means to represent the information in a meaningful form, (3) provide a means for the decision maker to operate on these representations, and (4) to make the mechanics of operation as transparent as possible so that the decision maker can concentrate on the decision task rather than the manual operation of the computer system. (Moy, 1983)

The design of the user-computer interface has far-reaching consequences. It may have a great deal of impact on the total cost of a computer system, since user-friendly interfaces may reduce training costs, which can be a major component in total life cycle costs. In addition, an optimal interface may affect performance efficiency and user acceptance. Acceptance may be an especially important consideration in a DSS, where users without extensive computer background want to perform rather complex operations in an intuitive way.

DSS Development Approach

Considering the issues raised above, a user-oriented model of DSS development was synthesized for the present effort. This approach is a composite of techniques recommended by other DSS developers (King & Cleland, 1975; Nutt, 1986; Stabell, 1983), supplemented to address decision requirements faced by Navy base and station command staffs. It consists of several discrete phases and steps: (1) decision task analysis, (2) selection of decision tasks to support, (3) descriptive analysis of specific decision processes, (4) conceptual definition of DSS, (5) development and integration of tools, and (6) test and revision (Figure 1). The first three steps comprise a requirements definition phase; the next two steps are part of a design and development phase. The final phase encompasses operational test and revision of the DSS.

Step 1: Decision Task Analysis. The first step, seen as the core of the DSS development process, is to gain an understanding of the user's problem solving and decision making responsibilities. Although one could make educated guesses about which decision making aspects of the job might benefit from assistance, it is best if the developer has first-hand knowledge of what the user does and how he or she does it. Ideally, the developer of a DSS should begin system development by working alongside users to gain an understanding of their job demands that could be supported by a computer. Short of the ideal, the users may act as informants in a job task analysis. It is difficult for developers to understand the needs of users without delving deeply into the users' environment and collecting data that help describe the demands placed upon managers. Data must be gathered about the frequency and importance of decision tasks and, if possible, the costs associated with these tasks.

Step 2: Selection of the Decisions to Support. The next step in the development process is to select decisions associated with critical job tasks that could be supported by a DSS. There are several important questions to answer in choosing decisions to support. What decisions are being made to accomplish critical job tasks? Are decisions based on information that could be provided by an MIS? Could components of this decision be modeled on a computer system? Does the user want assistance with this decision? Is it cost-effective to develop a DSS component to assist this decision? When selecting decisions to assist, the developer is, in essence, establishing the goals of the DSS. These goals should be discussed with users to verify that the selected decisions are indeed ones that users would want to have supported.

Definition Phase

1. Decision task analysis

2. Selection of decisions to support

3. Descriptive analysis of decision processes

↓

Design & Development Phase

4. Conceptual DSS definition

5. Development and integration of tools

↓

Operational Test & Revision Phase

6. Test and Revision

Figure 1. DSS development approach.

Step 3: Descriptive Analysis of Decision Processes. The DSS developer next documents the nature of the existing processes for the selected decisions to gain a more complete understanding of the factors and methods involved. The developer must examine such things as the type of information required; how the information is currently handled and stored; the manner in which users prefer to see information displayed; methods by which information is combined for consideration, decision criteria, and algorithms; and constraints that impact decision making. This examination provides the DSS developer with both the data element requirements and the information processing methods users apply in solving problems that are data-based. Analyses of this data lead to models of user's cognitive processes and provide the basis for ideas regarding the types of decision support to be incorporated into the DSS design.

This completes the definition phase of the DSS development process. The next phase, design and development, poses the challenge of matching user needs and capabilities with computer technology.

Step 4: Conceptual Definition of the DSS. Using the information gathered in the requirements definition phase, the DSS developer must create an overall DSS concept. This concept should not only focus on decision tasks to be assisted, but recognize the user's tendencies, preferences, capabilities, and limitations, and matching them to the available information system/DSS technology. Assistance may take several forms depending on the user's needs. For example, if a decision process is difficult because

the decision maker must simultaneously consider the exact values of several variables over a protracted period of time, then display techniques might be explored to aid the user's memory. In another case, if the user must monitor data to discover patterns over time, then statistical trend analysis tools could be provided. Patterns or relationships might also be revealed by displaying information to the user in various ways, such as through graphs, charts, and timelines.

Other characteristics of the decision tasks and decision process must also be considered in the conceptual definition of the DSS. The definition should address the incremental nature of many decision processes and also the fact that several parties may be involved jointly or sequentially during the decision process.

Hardware and software systems cannot be selected or developed independently by the DSS designer because they jointly determine ultimate system capabilities. For instance, text-oriented hardware systems (and associated operating systems) constrain the conceptual definition of the DSS by eliminating the possibility of user-friendly graphic interfaces and graphic information displays. Ultimately, what should emerge from the conceptual definition stage is a clear concept of a managerial workstation tailored for decision support. Just as with software development, the hardware specifications for this workstation should emanate from prototypes tested both in the laboratory and in the field.

One vehicle for refining the conceptual definition and translating it into a working form is prototyping. This is a convenient technique by which design concepts can be demonstrated in a concrete manner. It also provides a means by which ideas can be communicated between system developers and system users. Prototyping allows users to evaluate ideas and provide feedback to developers on how to modify their concepts to more closely meet user needs. It can ensure user evaluation and input throughout the development cycle. It may also be appropriate at this stage to evaluate prototype models experimentally to more precisely measure their impact on user performance and satisfaction.

Step 5: Development and Integration of Tools. The conceptual definition of the DSS provides a framework for breaking down the development task into components that can later be integrated into a complete DSS. Initially, the developer may pursue more detailed definition of prototype models of specific decision support tools and aids. These prototype tools can then be converted into fully functional tools to assist users with components of the decision process. When development of various aids and tools is complete, they can be incorporated into an integrated DSS. Of course, the DSS software must have its complementary hardware in order to be a fully functional system that provides the capabilities required in a form acceptable to the users.

At this point initial concepts have been translated into a fully operational system that can be delivered to the user. However, a final developmental phase, operational test and revision, is required to verify whether or not the system is meeting user needs and, where it is not, to modify accordingly.

Step 6: Test and Revision. Computer users have become accustomed to the fact that software and hardware are in perpetual evolution. In fact, there are instances when initial users have later come to see themselves as beta (final) testers of new software or hardware technology. Because the completion of beta testing is an arbitrary point in time, developers should deliver the DSS system to the users with the expectation of receiving feedback on its strengths and shortcomings, which then need to be addressed by further development efforts in order to deliver an improved system at a later date.

The Bases and Stations Information System (BASIS)

Managers of Navy bases and stations have the responsibility of providing a number of landlord functions for a large, highly transient population. Current management decision making procedures are not usually assisted by computers. BASIS is designated in the Navy Strategic Plan for Information Systems, SECNAV Notice 5230 of 27 February 1985, "as the standard automated information system in support of all base and station commanding officers, targeting landlord functions and requirements." The objective of the BASIS development team is to produce systems that will improve management control, optimize productivity, and minimize operating costs at bases and stations.

In an earlier effort, the job tasks and information requirements of COs and XOs of U.S. Navy bases and stations were analyzed to provide input into the development of a DSS for BASIS (Stuster *et al.*, 1987). It was clear upon completion of that effort that the analysis of decision support requirements had to be extended to the department head level, where many of the daily decisions concerning base/station functions are made and carried out. These top-level line managers are expected to be the most active users of BASIS.

APPROACH

Subjects

A subset of Navy bases and stations was chosen as a representative sample of BASIS users. Sites were selected to represent a cross-section of both major command types (naval stations, naval amphibious bases, naval air stations, etc.) and regions (West Coast, East Coast). The BASIS team contacted department heads representing six functional areas: (1) administration, (2) civil engineering/ public works, (3) comptroller, (4) safety, (5) security, and (6) supply. All department heads in these functional areas were asked to participate in the task analysis and interview.

Automated Job Task Analysis

The development team adapted a procedure used by Stuster *et al.* (1987) to support this effort. Two major changes were made in the procedure: (1) a task set appropriate for department heads was created, and (2) the task rating procedure was automated on a portable microcomputer.

Stuster *et al.* (1987) developed a set of job tasks based on interviews with COs and XOs of Navy bases and stations. This set of job tasks was modified to be relevant to Navy base and station department heads representing a variety of functional areas. Staff organization manuals (e.g., Navy Instruction 5450) and manager position descriptions from Navy bases and stations were used to develop the new task set. Only tasks amenable to MIS/DSS support were included; a comprehensive job task analysis of the six functional areas was beyond the scope of this project. Task items were substantially shorter than and represented in number less than two-thirds of those used by Stuster *et al.* (1987). The final task set comprised 70 tasks (See Appendix A).

A computerized item rating procedure was developed so that the task analysis could be administered using a portable microcomputer. All task analysis questions were presented on the computer screen. The subject responded by typing in the appropriate number and then pressing the return key.

Interview Questions

Following the automated task analysis, subjects were interviewed using a semi-structured format. The interview questions centered on three areas: (1) department heads' perceptions of BASIS, (2) their interests and needs in terms of MIS/DSS support, and (3) department performance indicators.

Procedure

Interviews were scheduled in advance on a command by command basis, usually with the help of a management assistant at the command. The interviews lasted from 60 to 90 minutes, and started with a discussion of BASIS and the purpose of the project. The computerized data collection began with the interviewer entering a unique identification number for each department head and the answers to a series of demographic questions. The questions concerned the size of their departments, the number of people they supervised, the length of time they had been in their department head positions, and their experience with computers and several kinds of software.

Department heads were then asked to estimate the distribution of their time, by percentage, in carrying out eight management functions, as identified by Mahoney, Jerdee, and Carrol (1965) and modified by Stuster *et al.* (1987) for the BASIS effort.

The respondents were given a worksheet defining the eight dimensions (Figure 2). The same worksheet was used to record their estimates before entering them into the microcomputer.

CATEGORIES OF COMMAND TASKS

Please estimate the proportion of your duty time devoted to each of the following categories of management tasks.

1. Planning: *Determining goals, policies, and courses of action. Work scheduling, budgeting, setting up procedures, setting goals or standards, preparing agendas.* ☐

2. Investigating: *Collecting and preparing information, usually in the form of records, reports, and accounts. Inventorying, measuring output, preparing financial statements, record keeping, performing research, job analysis.* ☐

3. Coordinating: *Exchanging information with people other than subordinates (such as commanders of tenant commands) in order to relate and adjust programs. Advising other departments, expediting liaison with other commanding officers or executive officers, arranging meetings, informing superiors, seeking the cooperation of other departments, activities, or organizations.* ☐

4. Evaluating: *Assessing and appraising proposals of reported or observed performance. Officer, enlistee, or civilian employee appraisals; judging output records, judging financial reports, conducting facilities or personnel inspection, approving requests, judging proposals and suggestions.* ☐

5. Supervising: *Directing, leading, and developing subordinates. Counseling subordinates, training subordinates, explaining work rules, assigning work, handling complaints of subordinates.* ☐

6. Staffing: *Maintaining the military and civilian work force on the base or station. College recruiting, civilian employment interviewing, selecting civilian employees, placing civilian employees and military personnel, assessing and recommending promotions, transferring personnel.* ☐

7. Negotiating: *Purchasing or contracting for goods or services, negotiating for facilities, contracting suppliers, dealing with sales representatives, publishing general information on the facility, collective bargaining.* ☐

8. Representing: *Advancing general Navy or base/station interests through speeches, consultation, contacts with individuals or groups outside the organization. Public speeches, formal and informal public and private gatherings, community drives, news releases, club meetings.* ☐

TOTAL 100%

Figure 2. Categories of command tasks.

The task analysis procedure began with respondents rating the frequency of the 70 tasks. The first screen (Figure 3) presented an example so that respondents could gain familiarity with the procedure and the rating scale.

On average, how frequently do you . . .

Track repair of facilities and equipment?

0	1	2	3	4	5
Never	Less than 4 times per year	Quarterly/ Bimonthly (4-10 times per year)	Monthly (1-2 times per month)	Weekly (1-3 times per week)	Daily (5+ times per week)

Figure 3. Example of frequency item.

Upon completing the frequency ratings, they rated the importance of those tasks that they reported in the frequency ratings to have encountered in their jobs. Again, the first screen provided an example (Figure 4). Finally, the participants were asked to provide a rough estimate of the number of hours required to complete each of 20 tasks selected by the investigators. This was done in an effort to establish a performance baseline to be used in later evaluations of MIS/DSSs. Because of time constraints, data on only 20 tasks were collected.

How important do you feel it is to . . .

Track repair of facilities and equipment?

0	1	2	3	4
Not Important		Moderately Important		Highly Important

Figure 4. Example of importance item.

Upon completion of the computerized task analysis, respondents were asked several open-ended questions concerning the availability of computer hardware and software, department needs in terms of MIS/DSS, and measures they use to gauge their departments' performance. The interview was concluded with a request for examples of typical forms completed and reports generated by the department.

RESULTS

Demographic Data

Eighty-two interviews were conducted at 16 Navy commands. The number of interviews conducted by command is presented in Table 1.

Table 1

INTERVIEWS BY COMMAND

Command	*Total*
Naval Station *(n = 23)*	
Mare Island	6
Norfolk	6
San Diego	5
Treasure Island	6
Naval Air Station *(n = 26)*	
Alameda	4
Miramar	5
Norfolk	6
North Island	6
Oceana	5
Naval Amphibious Base *(n = 10)*	
Coronado	5
Little Creek	5
Naval Medical Command *(n = 10)*	
Oakland	5
San Diego	5
Naval Communications Station, Stockton	5
Naval Training Center, San Diego	5
Naval Submarine Base, San Diego	3
	82

The number of interviews conducted in the six different departments, or functional areas, is presented in Table 2. At some commands the department head functions were combined, resulting in one interviewee representing two functional areas. In these cases the interviewees were classified according to their primary job responsibilities. The commands visited ranged in size from small medical commands (n = 6) to very large naval bases (n = 99,000).

Table 2

INTERVIEWS BY DEPARTMENT

Department	*Total*
Administration	15
Civil Engineering/ Public Works	14
Comptroller	14
Safety	16
Security	13
Supply	10
	82

The majority of the departments where interviews were conducted were headed by military personnel (n = 56), who had been in their positions an average of 2.9 years. Table 3 presents a summary of descriptive information on each department or function. The rank of those interviewed among military personnel varied from chief warrant officer to commander, and from GS-11s to GS-13s among civilian personnel.

Table 3

DEPARTMENT CHARACTERISTICS

Department	*Average Size*	*Average Number of Military*	*Average Number of Civilian*	*Dept Head's Years on Job*	*Dept Head Supervisees*
Administration	40	32	8	2.4	7
Civil Engineering/ Public Works	85	14	71	1.5	5
Comptroller	55	8	47	5.4	4
Safety	8	4	4	3.1	5
Security	102	55	47	3.0	14
Supply	165	86	79	1.2	21
Average Overall	76	33	42	2.8	9

Computer Experience

Department heads were asked to rate their personal experience with computer programs and applications on a 5-point scale, from inexperienced (0) to very experienced (4). The results are presented in Figure 5.

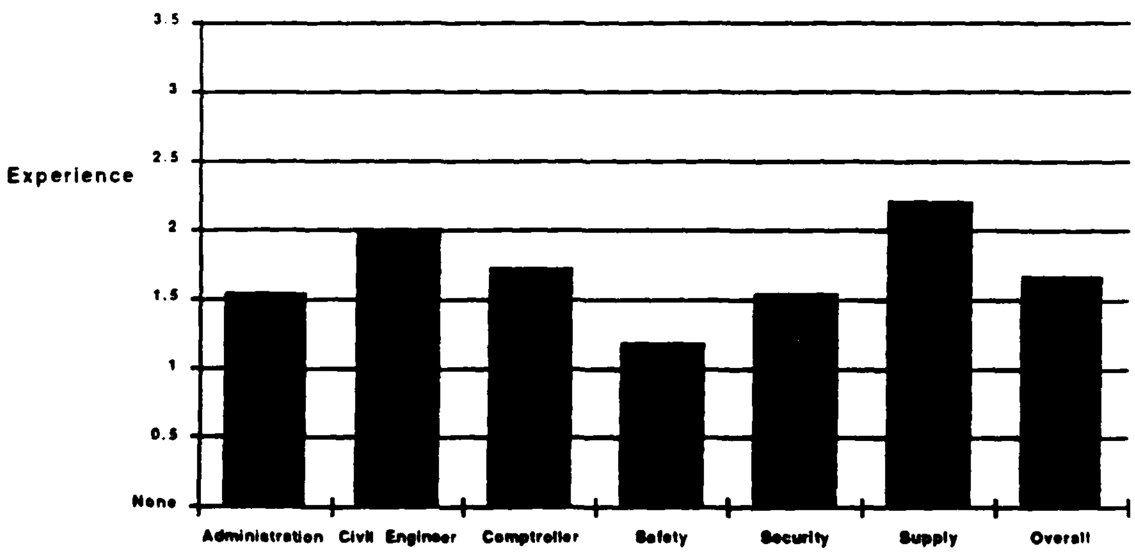

Figure 5. Average computer experience reported by department heads.

Department heads were also asked if they had personally used any of four different types of software (word processing, database, spreadsheet, and communications). The most common type used was word processing. Next, in decreasing order of use, were database programs, spreadsheets, and electronic communications. Previous experience apparently varies in relation to department activities. Figure 6 displays department heads' ratings of computer software use.

Department heads were asked if they themselves currently use a computer on the job. Overall, 39 percent responded positively. Comptrollers and safety department heads represented the largest group of computer users (50%), with supply department heads the smallest (10%). Use of computers by department heads was greatly determined by the availability of computer hardware and software in the department. People could hardly be expected to provide their own equipment. Nonetheless, there were several individuals who felt so strong a need to computerize their work that they employed personally owned systems.

Job Task Frequency Ratings

Department heads rated the frequency of occurrence of the 70 tasks on a 6-point scale that ranged from "never" (0) to "daily" (5) (Appendix A). Average frequency ratings ranged from slightly less than 4 times annually to almost daily. A listing of the ratings of the 70 tasks in terms of frequency can be found in Table B-1 of Appendix B. An overall mean task rating was calculated by combining the ratings across the six departments. From these overall frequency ratings, the following 14 tasks were reported as most frequent (in descending order of frequency):

- Generating routine correspondence;
- Scheduling own daily activities;
- Monitoring progress of department tasks;
- Generating non-routine correspondence;
- Coordinating responsibilities with other department heads;
- Setting department work priorities;
- Determining the impact of other departments' activities on one's own department;
- Coordinating use of department resources;
- Planning upcoming events for which the department is responsible;
- Tracking the morale of department personnel;
- Generating possible solutions for facilities or equipment problems;
- Assessing the workload of department personnel;
- Generating possible assignments of personnel to match workload; and
- Assessing overall productivity of the department.

These tasks were all rated as being performed at least monthly. Tasks 1-9 and 14 were all from a subset designated *a priori* as "operations management."

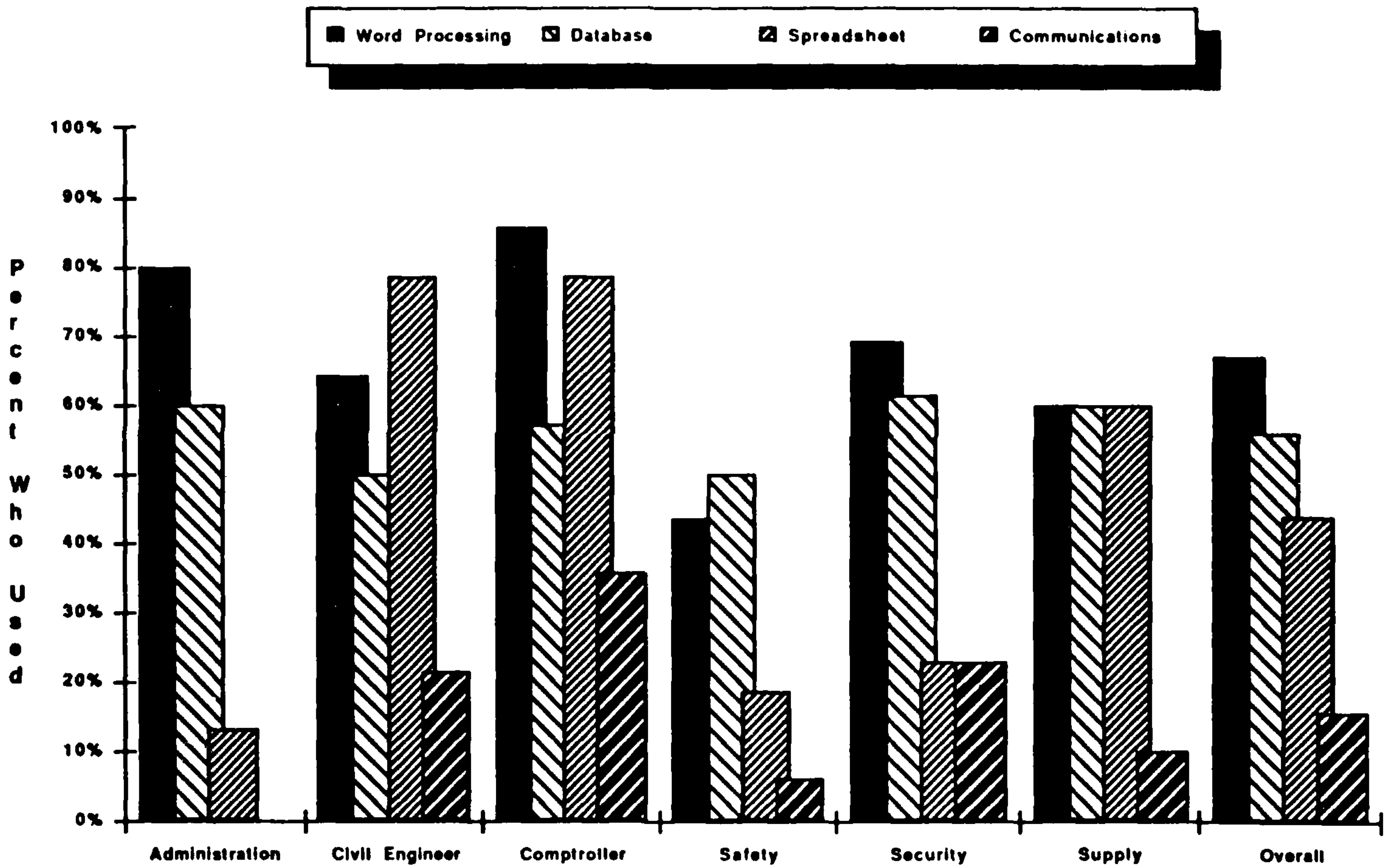

Figure 6. Computer application use reported by department heads.

Frequency Ratings by Department

Generating routine correspondence (Task 39), which was the most frequent overall task, was rated highest in frequency by heads of five of the six departments (see Appendix B). However, most of the remaining 69 tasks were less consistently rank-ordered across departments. A nonparametric statistical test (Kendall's Tau) was calculated to compare the rank orderings of task ratings across the six departments. This test shows a measure of agreement between the rankings by different groups. These results are presented in Appendix C. The similarity between departments in the rank orderings of the 70 tasks was compared. All of the comparisons were statistically significant.

When comparisons were made to determine which department's ranking was most representative of all the departments taken as a whole, it was found that the supply department rankings had the most overlap with the other departments. Of the 14 tasks cited as most frequent (overall), supply department heads included 13 in their top 14. The other departments heads cited fewer tasks that overlapped: 12 of the 14 tasks for administration officers, 11 of the 14 tasks for safety and security officers, 9 of the 14 tasks for civil engineers, and 8 of the 14 tasks for comptrollers. In looking at the similarity of task frequencies, it appears that a core group of tasks occurs across departments.

Frequency Ratings by Command Type

The 16 commands at which interviews were conducted were grouped into three categories: air stations, naval stations, and others (including amphibious bases, communication stations, medical commands, training centers, and submarine bases). Statistical tests comparing the rankings of tasks across the three command types revealed that a very high degree of agreement exists (Appendix C). From this finding it is clear that department heads at the various commands surveyed are similar in terms of the frequency of task requirements they encounter.

Frequency Ratings by Problem Solving Level

The 70 tasks were broken down into subsets according to stages in a general problem solving/decision making model, namely, (1) identifying problems and causes, (2) generating action alternatives to solve the problem, (3) evaluating these alternatives, (4) planning changes, and (5) implementation. The average frequency ratings for tasks at each problem solving level show minimal differences. In general, "generating alternatives" is the most frequent activity in all departments, with the exception of the safety department, where "implementation" is most frequent. "Evaluating alternatives" occurs least frequently in all departments.

Job Task Importance Ratings

Department heads rated the importance of the 70 tasks on a 5-point scale from "not important" (0) to "highly important" (4) (Appendix A). Average importance ratings ranged from "slightly important" to just under "highly important" (Table B-2 in Appendix B). Again, ratings in the six departments were combined and averaged to produce overall importance ratings for the 70 tasks. The 14 most important tasks, in descending order, were:

o Coordinating responsibilities with other department heads;
o Determining adequacy of department resources;
o Setting department performance goals;
o Monitoring progress of department tasks;
o Determining the impact of other departments' activities on one's own department;
o Setting department work priorities;
o Generating possible solutions for facilities or equipment problems;
o Scheduling own daily activities;
o Assessing overall productivity of the department;
o Planning upcoming events for which the department is responsible;
o Prioritizing department activities for the year;
o Tracking the morale of department personnel;
o Preparing appraisal forms for subordinates; and
o Developing proposed annual budgets.

Review of these tasks shows 10 of the 14 tasks to be from the operations management domain. This is a disproportionately large number, indicating that managers view operations management tasks as relatively more important than facilities, personnel, and financial management tasks. Facilities management tasks were distributed widely over the entire range. Nearly half of the personnel management tasks were rated in the bottom 14 of importance ratings.

Importance Ratings by Department

Importance ratings of tasks were more variable among departments than their frequency ratings. Of the 14 most important tasks overall, comptrollers rated only 4 of the above tasks in their top 14. Civil engineers, safety, and security department heads had 8 of the above tasks in their top 14. Supply department heads had 9 and administration department heads had 10 (Appendix B). Those tasks rated as more important by a specific department compared with the overall ratings tended to emphasize issues relevant to the charter of that department. For example, 4 tasks administration department heads included in their 14 most important tasks but not found in the overall top 14 related to personnel (requirements and workload determination, selection, and personnel security policy). Similarly, 5 of the 6 tasks rated as more important by civil engineers but not in the overall top 14 had to do with facilities and equipment (status assessment, projecting requirements, planning and scheduling upgrades).

A comparison of the similarity of task importance rankings across the six departments was conducted (Appendix C). The comptrollers' rankings were least likely to agree with other department heads' importance rankings, differing as they did from those of administration, safety, and security department heads. In addition, administration department heads and civil engineers had relatively low consensus.

Important Ratings by Command Type

Just as was found in the analysis of frequency ratings, importance ratings of tasks were found to be similar across commands types. Nonparametric comparisons of the three base groups (air stations, naval stations, and others) showed the existence of similar rank orderings for the 70 tasks (Appendix C).

Importance Ratings by Problem Solving Level

In general, all levels of problem solving were rated as relatively equal in importance by department heads. Across departments more variability is apparent. Civil engineers placed relatively high importance on "planning"; comptrollers on "generating alternatives" and "planning"; administrators on "implementing"; security officers on "planning" and "implementing"; and supply on all phases. Safety department heads tended to rate "identifying" relatively low, with all other problem solving phases consistently high.

Combined Task Frequency and Importance Ratings

The similarity in the rank ordering of the overall frequency ratings and overall importance ratings was measured using Kendall's nonparametric test ($\tau = .49$; $p < .01$). The scattergram for frequency plotted against importance (Figure 7) shows some linearity, although high levels of importance were assigned to tasks with a broad range of frequencies.

Six tasks were ranked in the top 10 on both frequency and importance. These were:

- o Setting department work priorities;
- o Planning upcoming events for which the department is responsible;
- o Coordinating responsibilities with other department heads;
- o Determining the impact of other departments' activities on one's own department;
- o Monitoring progress of department tasks; and
- o Scheduling own daily activities.

Only five more tasks achieved joint rankings in the top 20 of both frequency and importance ratings. These were:

- o Generating possible solutions for facilities or equipment problems;
- o Tracking the morale of department personnel;
- o Assessing overall productivity of the department;
- o Coordinating the use of department resources; and
- o Preparing materials for briefings.

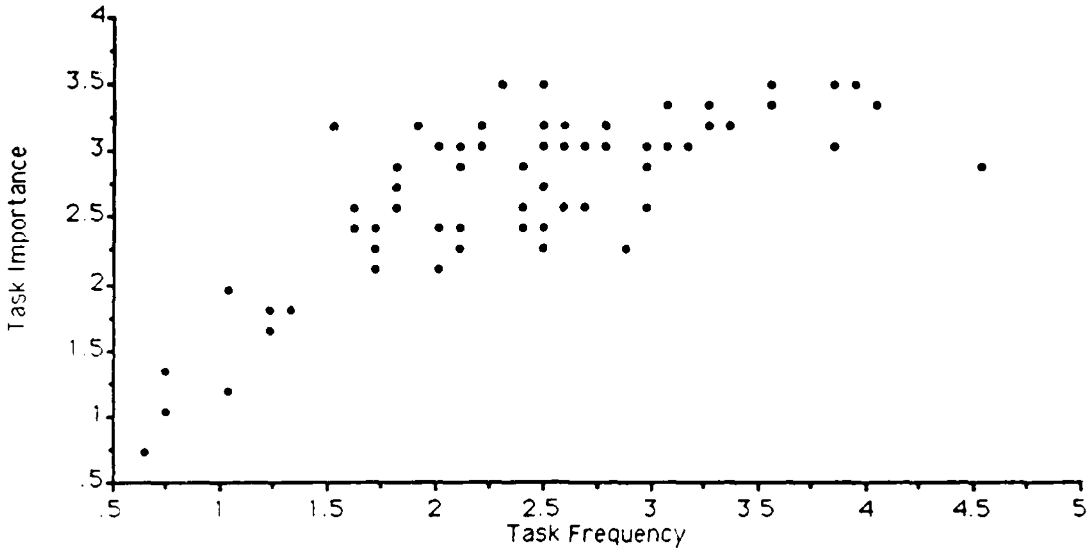

Figure 7. Scattergram of mean ratings of task frequency and task importance.

Generally, as frequency ranking declined, importance ranking declined. However, some tasks were rated relatively high in importance though they had moderate to low frequency rankings. Examples were:

- o Setting department performance goals;
- o Determining adequacy of department resources;
- o Prioritizing department activities for the year;
- o Preparing appraisal forms for subordinates;
- o Developing proposed annual budgets; and
- o Selecting prospective personnel.

Combined Ratings by Department

There was a marked similarity across departments of the combined task frequency/importance ratings. Nonparametric measures of association among the various department pairs ranged from tau = .46 to .62 (Appendix C). All ratings of department pairs attained statistical significance ($p < .01$).

Department Heads' Estimates of Hours

Interviewees provided estimates of their annual time expenditures on 20 of the 70 tasks for which they gave frequency and importance ratings. The most time-consuming tasks in this set (in descending order) were:

- o Coordinating use of department resources;
- o Tracking repair of facilities and equipment;
- o Projecting facilities/equipment requirements;
- o Evaluating expenditures compared to funding support;
- o Preparing materials for briefings;
- o Preparing routine department status reports;
- o Monitoring department activity levels to identify personnel requirements;
- o Scheduling own daily activities;
- o Tracking resource requirements; and
- o Developing proposed annual budgets.

Each of these 10 tasks required an average of an hour and a half to two and one half hours per week. Department heads commented that it was very difficult to provide accurate hourly estimates for these tasks, but rough estimates were provided.

Time Distribution Across Management Functions

Department heads overall reported that they spend the largest proportion of their time on planning (26%). Other managerial functions demanding major portions of time were investigating (19%), coordinating (15%), evaluating (14%), and supervising (12%). The remaining 14 percent of department heads' time is distributed fairly evenly over staffing, negotiating, and representing. Compared to an earlier study of COs and XOs (Stuster *et al.*, 1987), department heads spend much more time planning and investigating, and much less time supervising and coordinating. The COs stand out as doing much more representing and much less investigating than either XOs or department heads. These results are presented in Figure 8.

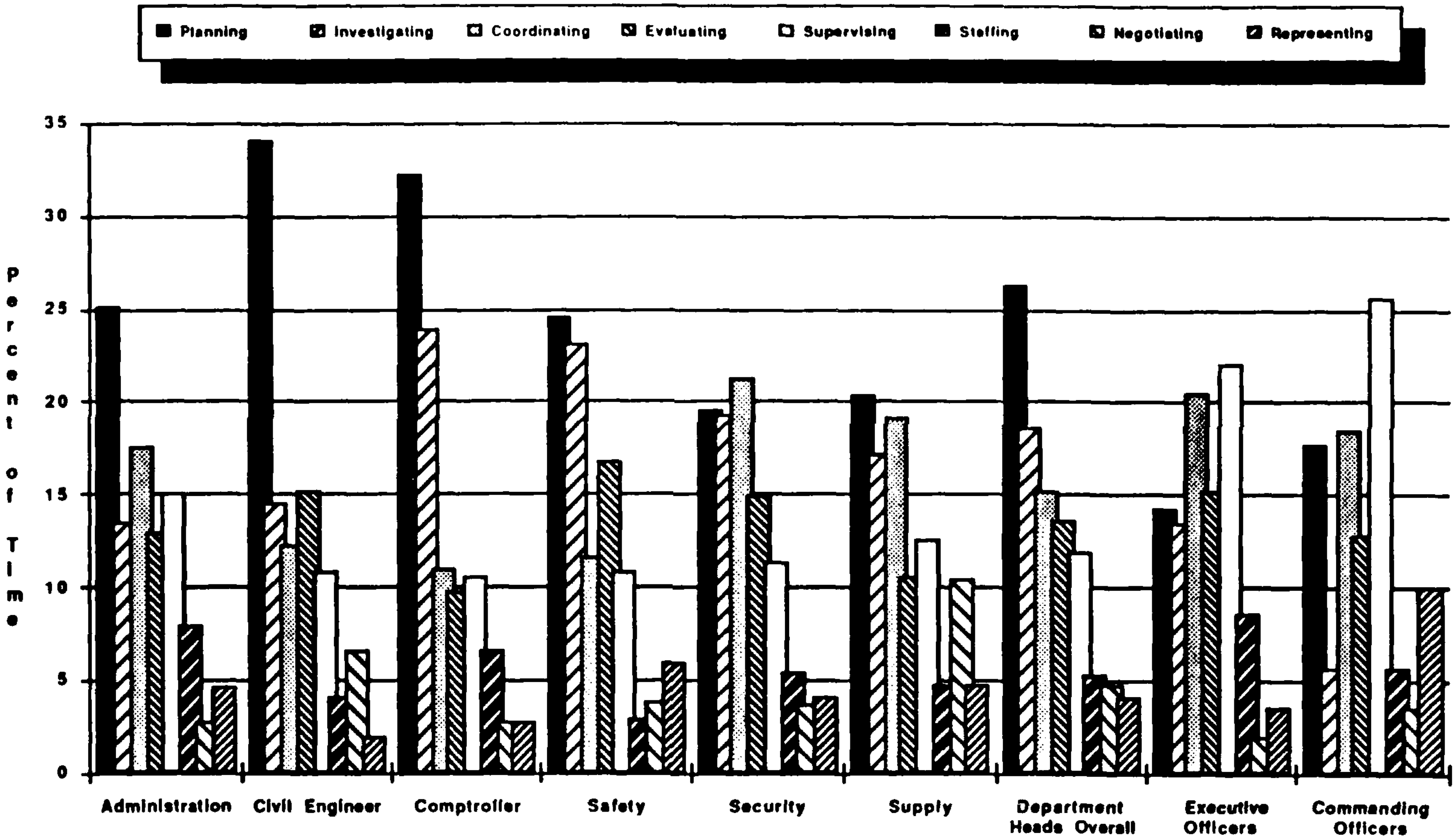

Figure 8. Base/station managers' distribution of time across management functions.

Attitudes Towards Computer Support

Almost all department heads felt that computerization would improve the performance of their departments. Many expressed a desperate need for computer hardware and software, and noted specific ways in which it would be put to use to save labor, overcome personnel shortages, improve work quality, allow quicker response time, etc. However, the use of computers was not regarded as a simple, entirely positive proposition. Department heads with exposure to the implementation of other Navy automated data processing systems pointed out shortcomings in many of these systems, and they had no reason to expect new systems to be much different. There were strong feelings that system designers sought very little participation from the intended users in the development of new systems. There might be a few interactions between the designers and the users in the initial stages of development, but system developers tended to drop out of contact, not appearing again until much later with a system that had been developed beyond a point that users could help to remedy. The concept of prototyping with the active participation of users is still not used to its best advantage.

The majority of the department heads had some knowledge of BASIS. Most had read or heard about it. Some had received hands-on exposure to prototype BASIS modules. Some department heads had reviewed the functional descriptions for the BASIS modules and provided input to the Navy Regional Data Automation Command (NARDAC) developers. Most of the department heads were very supportive of the BASIS development effort. Those expressing a less enthusiastic view feared BASIS would not integrate with other systems such as COPS, IDAFMS, and BEST, also developed to assist base and stations departments. They were also concerned that BASIS would duplicate systems they had developed themselves. Lastly, some department heads expressed concern for the training time needed to effectively use the new system.

Current Computer Capabilities

The majority of the department heads interviewed function with little or no computer automation. Most department information is recorded, maintained, and updated manually. The 3x5 card index system was operating in many departments. When there is a request for information, a time-consuming process of manually locating, tallying, and summarizing the information usually occurs. Where automation does exist, the department usually has a few Zenith personal computers, an NBI system, WANG mainframe terminals, or, in a few exceptional cases, Macintosh computers. These systems are used for word processing, database management, or financial spreadsheet applications. Automation with respect to comprehensive databases dedicated to departments is a new idea at most Navy bases and stations.

One of the most interesting phenomena observed is the grass-roots efforts of departments to obtain computer hardware and develop software to meet specific needs within their departments. For example, a safety department developed a DBASE III program to track personal injuries; a comptroller department transfers data from financial reports to LOTUS 123 to generate summaries for the CO; a civil engineering department uses a Macintosh graphics program to generate and modify building plans. Department heads demonstrated ingenuity in using old equipment as well as the personnel on hand to develop useful systems.

Department Heads' Computer Needs

Even without extensive exposure to ADP systems, department heads readily expressed many needs in terms of computer support. Several of these needs applied to all departments, such as the need to:

- o Respond to a greater number of data requests;
- o Respond faster to data requests;
- o Create more accurate data;
- o Create more up-to-date data;
- o Access a larger number of data fields;
- o Reduce hardcopy reports;
- o Analyze patterns;
- o Discover discrepancies; and
- o Project events in the future.

Other needs were specific to departments. These are summarized in Appendix D.

Department Performance Indices: Possible Evaluation Criteria for MIS/DSS

Department Heads said that they employed traditional indicators to measure performance, with some modifications or tailoring within the context of specific department services or activities. The bulk of the indicators were related to accuracy of department outputs, quantity of department output, timeliness of responses to other commands and customers, speed and efficiency of department services, and department productivity. More subjective measures included feedback from customers, response from higher commands, and the department head's perceptions of effectiveness. See Appendix E for a description of indicators by department.

DISCUSSION

The user-oriented model of DSS development guided the efforts to this point quite well. This development approach provided a framework within which to structure the DSS design. The task analysis and interview procedure allowed the designers to become familiar with the kinds of responsibilities that face department heads of Navy bases and stations and gain an understanding of some of the decisions they face. It made possible isolation of those tasks that department heads see as critical in meeting their job responsibilities. The interview was useful in gauging user interest in decision support, critical to the success of a DSS. During the interview session, many department heads discussed critical ongoing tasks that would be greatly assisted by decision support. In general, department heads were very positive towards any movement to provide them with computer assistance. Although there is skepticism about whether the systems will truly be state of the art, few would turn down computers offered to them.

Comparisons Across Departments and Commands

Design of a DSS for the top management of bases and stations hinges on, among other factors, the degree of similarity among department heads in terms of tasks and information requirements. One aspect of this issue is the extent to which department heads do the same things, regardless of their department and functional requirements. This might be understood as a question of form. Another aspect is whether the required problem solving and decision making activities differ because of the data peculiar to each functional area. This might be seen as a question of content. To the extent that form is similar across departments and bases, a case could be made for development of a DSS that provides generic tools usable by the entire top management team, regardless of functional area or hierarchical position.

The job task analysis allowed the developers to compare the ratings of a set of job tasks across different department types and command types. In overview, the task frequency and importance ratings from the department head interviews display a high degree of similarity across departments and across commands. Thus, it appears that many tasks performed by department heads occur with similar relative frequency in different departments and on different bases. Although there is somewhat more variability in importance ratings, these also display considerable similarity across departments and bases. It appears that the Navy context shared by these commands and departments generates a common set of requirements. Tools to assist decisions affecting these critical tasks should be applicable to all the department heads interviewed.

Comparison with COs and XOs

The data gathered in this study only allow comparison of the department head data with the CO and XO data (Stuster *et al.*, 1987) in regard to distribution of time across management functions. Of the three top management groups, department heads reported the highest proportion of time spent in planning and in investigating; they reported less time spent in supervising and coordinating than did either XOs or COs. Of the three groups, XOs claimed the highest proportion of time devoted to staffing and the least to negotiating and representing. COs reported a more public role (representing) than did the others, as well as a relatively large proportion of time spent in supervising and planning. They reported relatively little time spent in investigating (Figure 8).

In terms of DSS design, the data may have two implications. First, the distribution of time across management functions may be seen as documenting the relative needs of the various managers for computer aiding. A second implication is that

a DSS may assist managers in performing tasks in a more expedient manner, allowing the redistribution of time.

Department heads generally agreed that their COs and XOs are interested in the general status of departmental activities and outcomes. COs typically hold regular meetings with all department heads, and usually during these meetings all department heads provide a departmental status report. Department heads were often the primary players for identifying and resolving problems in their own departments. One of the most basic requirements for a DSS is that it should have the capacity to summarize data so that department heads can provide their COs and XOs with general status information. As an example, one safety officer told us he had developed a chart format for periodic reporting to the CO. He regularly updated the CO on a standard set of safety categories, and compared these with the previous year as a normative base period.

Desired System Capabilities

Department heads mentioned many features they would like in a DSS. This section summarizes three system capabilities department heads requested.

Electronic Mail

There was an overwhelming request by department heads for electronic mail. This was requested by department heads in all six departments. It was generally felt that electronic mail would greatly facilitate communication, reduce the need to "play telephone tag," and provide a way to use time more efficiently.

Networking and Data Sharing

Another common request was for networking or data sharing across departments and across databases. Most department heads felt that time, labor, and errors would be reduced if the information could be shared and transferred electronically. Department heads said that quick access to information that is not necessarily generated by their department would greatly facilitate their operations.

Ad Hoc Query Capability

All departments must regularly respond to unexpected situations and requests for information. This situation usually requires *ad hoc* review and tabulation of data. For example, administration might be requested to report the number of Hispanics on base; security, the number of DWI arrests at the front gate during the month; supply, the number of rejected requisitions during the past 60 days. These requests usually require a fast response and are for information not readily available from standard reports. Thus, the department head must turn his or her attention to the request by assigning personnel to it and perhaps becoming personally involved in information search, consolidation, and reporting. In some departments, such requests take up a considerable amount of the department head's time. Comptrollers, for example, have frequent interactions with their commanding officers about managing the budget, and must continually respond to CO requests for details and advice.

The common thread in such requests is the department head's need to obtain unanticipated information quickly. Unfortunately, there is no simple solution to the problem--no single application program that will fill the need for all departments. However, there are noteworthy implications for software architecture and design of user-machine interface. First, databases should be structured in a way that permits users to access their content systematically; for example, hierarchically organized, with the

user able to access data via any of its key dimensions or their combinations. Second, the user interface must permit the user to specify search criteria in a simple way. The current mainstream of database systems places too great a requirement upon the user to understand details about the database and its structure in order to use it. Most department heads are not computer experts and should not be expected to enter search specifications in the form of command strings of logical and relational operators; a more intuitive approach must be used.

Patterns of Information Use

Review of the task analysis data, interview data, and sample reports and forms submitted by department heads led to the conclusion that there are some basic patterns of information use in decision making to meet job demands. The choice of pattern in a particular situation may be governed by either the requirements of the decision or by personal preference for information handling. We have categorized these patterns of use as record keeping, tracking, and sleuthing. These patterns are similar across departments and bases. Although not every manager uses all patterns all of the time, the patterns suggest different decision support needs for different types of situations or problems.

Record Keeping

The first pattern involves entry, retrieval, and maintenance of data in a database to produce standard reports, generate inventories and lists, or perform other routine tasks. This pattern may be called record keeping. Much of what is done with data is simple classification of events or activities into standard categories. For instance, income and expenditures can be categorized by date, organizational unit, and type; or safety incidents can be categorized by date, type, severity, and work area. When reports are required, the data can be listed or summarized according to the various categories, for example, expenditures greater than $1000 by a department in a particular category during some period, or major accidents on the flight line during a defined period.

Often record keeping use is dictated by a reporting requirement from a higher authority, and the benefits to the particular department are indirect. This routine process can be mechanized to automatically produce this kind of information at both a detailed and summary level. This pattern epitomizes the automated record keeping and routine reporting capabilities of modern computer systems.

Many of the requests from department heads for future MIS/DSS capabilities reflected a record keeping orientation. These included requests for capabilities relating to data entry, database content, and report generation. With respect to data entry, several department heads requested improved data-entry screens. Suggested improvements included greater fidelity to paper forms, computer-based instructions and "help information" keyed to data-entry fields, and "forced-fit" data entry--the application forcing the operator to enter all required fields with appropriate form and content.

There were several requests for the computerization of records being kept manually (e.g., security department incident reports, safety deficiency notices). Many of these requests will be satisfied by BASIS. There were also requests for graphics capabilities not currently planned as part of BASIS. For example, several public works/civil engineering departments wanted the ability to store and retrieve maps and floorplans. Comptrollers and others wanted to be able to generate graphs and charts from existing data files either for their own use or for use in making presentations to commanding officers.

Department heads in all departments cited specific reports they would like but were unable to generate with current systems. For example, security department heads would like to maintain a database of incident reports and be able to search the database using open-ended search criteria. The same applies, with their own databases, to heads of other departments, for example, safety department databases of accident reports; comptroller and civil engineering/public works department databases of financial information; and administration department databases of personnel availability. What is common across departments is the wish to define report content and database search criteria. In simple terms, departments want flexible record keeping systems.

Tracking

The second pattern involves tracking time-dependent activities so that what needs to get done gets done when required and resources are used efficiently. Department heads have a pressing requirement to keep track of ongoing events. They may be involved in developing plans, executing projects, or managing their budgets. To accomplish this tracking function they currently use a wide variety of resources ranging from paper and pencil, to clipboard, to project management programs on microcomputers. Often department heads rely heavily on their own memory in monitoring the activities of their departments. Their success probably varies widely, depending on their abilities, tools, and perseverance.

This pattern is structured, but the structure is usually imposed by the department itself. Concrete examples include an administration department's use of a computer-based personnel log to keep track of the locations and rotation dates of TDY personnel; a priority list used by a civil engineer to keep track of building events; lists of inspection discrepancies and action dates maintained by safety departments. Such tracking activities directly benefit the department in executing its responsibilities and are not necessarily dictated by any external reporting requirement.

Department heads described several different types of tracking activities they need to perform. These differ among individuals and department types, but they share a common premise and have a similar goal, for example:

Premise: An event must occur at a particular time.
Goal: Assure that the event occurs.

The premise and goal are often influenced by "properties" associated with the event, that is, its type, priority, who is responsible for it, and so forth. When it becomes clear that circumstances do not permit all goals to be met, these other properties can be taken into account to ensure that the most consequential events occur.

Examples of events that must be monitored by different departments include:

Administration	Status of correspondence;
Comptroller	Status of accounts payable;
Civil Engineering/ Public Works	Status of work in progress;
Safety	Status of required periodic physical exams;
Security	Status of AWOL personnel cases;
Supply	Status of requisitions.

Though the events themselves differ, the manner in which they are monitored is usually quite similar. A time-ordered list of events is created. The manager checks the list periodically to ensure that events occur. As time passes, completed events are crossed off the list or status changes are noted and new events are added. Those overdue are given appropriate attention to get them back on schedule or otherwise dispensed with.

Department heads use many different tools to manage events. Though content and form differ, the underlying structure is most often a list. Individuals reported that on many occasions, however, a simple list was not dynamic enough to accommodate last minute changes or delays in scheduling. The interrelationships and dependencies of items on the list unfortunately too often resided within the memory of the individual in charge. These individuals are too often subject to the common problems of forgetting or confusion. The formal procedures for Gantt and PERT charting are too labor-intensive to be practical if done manually. It appears that many managers would be aided by an interactive, computer-based list management program that would permit the user to do the following:

1. Enter tasks or modify tasks;
2. Assign task or event properties (e.g., task type, priority, status, due date, responsible individual);
3. Sort the list by time or event properties; and
4. Filter the list to extract events meeting certain open-ended criteria (e.g., events of specified type and priority that are due during a particular time interval);
5. Create a graphic display or other easily grasped summary of current status at any time.

No software with all of these features is presently available, although computerized calendars, datebooks, and the like have some of the required features. Although the list is probably the simplest and most universal tool used by a manager, more sophisticated or specialized tools, such as project management software, would be useful. Bearing in mind the commonalities of these tracking requirements, system designers should develop a system for meeting department heads' tracking requirements.

Sleuthing

The third pattern, which we shall call sleuthing, involves examination of the contents of a database to find the answer to a non-routine, atypical question. It may also involve manipulation of data in the database in an analytic or evaluative approach. This pattern is less structured and less governed by external requirements than the two previous patterns. Concrete examples are multi-level analyses performed on financial databases to determine areas of over- or underspending, inappropriate budget allocation, or other discrepancies. Or data from one time period must be compared with another, with the user looking at historical trends as a basis for projecting into the future. This pattern is common in comptroller and civil engineering departments and, to a lesser degree, in supply. In general, the analyses performed benefit the department directly and are not usually dictated by an external reporting requirement.

To facilitate sleuthing, department heads requested capabilities to conduct several different types of analyses. Though these analyses differ by individual and department type, they have a common premise and intend to answer an often unstated, but underlying, question:

Premise (P): A problem may exist.
Question (Q): Does it and, if so, what is its source?

Examples of premises and questions are:

Administration
(P) Personnel are needed to accomplish a task.
(Q) Are personnel with the required skills available?

Civil Engineering/Public Works
(P) The rainy season is approaching and the roof of building 304 needs replacement.
(Q) Is the roofing job on schedule?

Comptroller
(P) The base is overspent on utilities.
(Q) Who is responsible and how may future costs be reduced?

Safety
(P) The base needs to reduce exposure to asbestos.
(Q) Where on base are asbestos hazards located and how are plans progressing to eliminate them?

Security
(P) The threat of terrorist attack has increased in recent weeks.
(Q) What are weak points in the base's security perimeter, and how may they be strengthened?

Supply
(P) A maintenance manager contends that requisitions are taking significantly longer to process than in the past.
(Q) Is the contention correct and, if so, what is the most likely reason?

Although the foregoing premise-question pairs are quite different, a department head attempting to deal with any pair is likely to go through a similar process. The steps in this process involve problem recognition and definition, generating and evaluating solutions to resolve the problem, and implementing solutions. Nothing can happen if the department head does not recognize the problem. Doing so requires experience and an indicator to alert the department head. Given these, the department head will typically focus on data to locate the problem source. For example, a comptroller attempting to learn why utilities are overspent will look at actual versus budgeted spending by department, compare current and past expenditures, and examine other financial indicators. This process is facilitated when the system (1) provides high-level indicators to flag potential problems and (2) is structured so that the user can focus on the database at successively finer levels of detail.

Another aspect of analyses performed by department heads concerns the predictability of problems before they occur, that is, predictive analyses. As in the analysis of existing problems, problem prediction is based on a premise and is intended to answer an underlying question:

Premise: A problem may exist in the future.
Question: Where will the problem occur and what will cause it?

Predicting problems is more difficult than detecting existing ones for several reasons. The department head must possess a reasonable model of the system in which problems may occur. S/he must be provided with "leading indicators" of potential problems. Then s/he must be able to interpret the indicators accurately. More fundamentally, a department head must have the proper mind set to think in terms of future events rather than simply reacting to present events. Several of the department heads we interviewed did attempt to make such predictions. Typically, these were managers who were computer-sophisticated. They usually were found in civil engineering, comptroller, and administration departments, although they could also be found in other departments. Most felt that they could be more effective if they had better predictive tools and more up-to-date information. Lack of adequate tools or accurate and timely information precludes developing useful predictive power.

While several of the department heads we interviewed attempted to anticipate problems, the majority did not--at least not in any formal way. For example, security departments gathered and submitted incident reports to higher levels, but did not always develop in-house statistics for predicting future incidents. Similar attitudes were evident in other departments. Most of the department heads we interviewed tended to take a reactive rather than a proactive stance toward problems. This may well be due to the lack of computer support and accurate, timely information that would allow them to take a more analytical, evaluative approach to management of their departments.

Many department heads requested a "what-if" capability in new systems. They want to be able to manipulate variables in a situation and calculate results under different conditions, as in spreadsheet programs. The question being asked in this case is, "If I provide these inputs, what will be the result?" The "what-if" question can also be framed to predict a result in terms of time (e.g., "If things continue as they have in the past, what will be the result four weeks from now?").

Thus, the "what-if" capability is a generalized way to make or test predictions. The "what-if" capability is also a feature of project management programs that predict the effects of personnel and physical resource allocations upon project costs and scheduling in graphic (e.g., Gantt or PERT charts) and tabular form. Few department heads use project management software. It is expensive, more difficult to use than a spreadsheet, and has less general applicability. However, such software would be very helpful to department heads who manage complex projects.

The three patterns of record keeping, tracking, and sleuthing are oversimplifications, but they provide a useful framework for structuring thought about how department heads typically use information and computer support to meet job responsibilities. Our survey suggests that the traditional orientation of a department in using a computer may influence department head perceptions of computer use. For example, where record keeping prevails (as it does in safety, security, and supply departments), the computer is regarded not as an analytical tool but as a record-keeping tool. In departments where tracking is evident (as it is in administration, comptroller, and civil engineering/public works departments), there is a strong computer orientation and often an expressed need for additional computerization. Tracking and sleuthing

often overlap, and where they are common (in comptroller and civil engineering/public works departments), department heads make more effective use of computers as analytical and management tools. These departments have generally also had a longer history of computer use than those characterized by a record-keeping orientation, and therefore their department heads generally have greater computer sophistication.

Many of the heads of these departments did not take a historical view of the computer records their departments generate; the attitude seemed to be that reports were generated because they were required by higher command. There were exceptions, however; for example, a security department head who used records of past incident reports to identify patterns for the purpose of allocating department resources. By providing department heads with computer tools of an analytic nature, these data may be used by them to identify and possibly predict problems, analyze solutions, and evaluate implementations.

MIS/DSS Evaluation

Automated systems designed to be used by managers are tools intended to increase managerial productivity in both qualitative and quantitative terms. Criteria for evaluating the impact of the implementation and use of such systems are the same performance measures traditionally used to assess department productivity. Although a lengthy discussion of the evaluation process is not the focus here, an effort was made to generate a group of department performance indicators for the six functional areas examined. It is recommended that these indicators be adapted to measure the effect of DSS implementation on department productivity.

A View of the User

It is fitting that we end this section with a brief description of how the user and the user's decision processes may be effectively visualized in the design of a DSS.

First, the user is not interested in the hardware, software, system architecture, or the operating system involved in an information system. The terminal or workstation is nothing more than a conduit through which the user hopes to be able to acquire or store desired information. The user appreciates a dialogue with the system that uses the vocabulary to which s/he is already accustomed. The user expects that the system, at a minimum, will automate the most routine operations performed on the job. It is permissible for data entry to require as much effort as manual procedures as long as the user perceives that retrieval, modification, and summary reports are greatly facilitated by the system.

Although it is often necessary to maintain two separate processes or systems (the old and the new) when initially implementing a system, it is important that the old system be eliminated as quickly as possible. Our studies disclose that users fear that they will have to maintain redundant information. For this reason alone, the design of a new system should provide for use of existing information whenever possible. This implies that the data element glossary of definitions be maintained rigorously to avoid needless redundancies as the system evolves. There are permissible exceptions when certain data elements are known to be error-prone or susceptible to change and require occasional verification.

Users expect a system to be useful immediately. They are not impressed with the technology--just the immediate results. So it is important in building a system that the developer address some straightforward tasks that are not currently handled well, making it easy for the user to employ the system to do these things. And, as in this

study, the developer must work closely with the potential user to determine what tasks are the best candidates for improvement through computerization.

In working with users during the development process, the developer must first seek to understand the range of tasks that the user performs in the course of performing the job. It is the responsibility of the system designer to convey to the user what part of that range can realistically be addressed by the system under consideration. We have found that users are not only helpful, but eager to assist in refining concepts and ideas into executable objectives. Here is where the technique of sequential prototyping is especially useful. Starting with a "storyboard" to show how the system might be used to accomplish a specific class of tasks or decisions, the developer can move iteratively toward a working prototype, using comments and critiques from the intended user. The user, at the same time, develops an understanding of the designer's efforts and constraints. This type of interaction and participation satisfies the user's needs and demands to be heard, fostering feelings of ownership, while providing the developer with needed information that goes a long way toward producing a successful system.

We have found that obtaining samples of summary notes and charts is a most enlightening technique for gaining information and ideas about the decision making process. These materials, which they have developed to help themselves, provide revealing insights into the mental processes individuals use. It is not likely that an individual will systematically gather and summarize information unless it is relevant to her/his decision process. Summaries and charts reveal how the individual prefers to see information displayed. If the rationales behind these summaries or charts are not obvious, the system developer should query the user for explanation. Additionally, summaries and charts provide ideas as to how information might be combined and used to estimate parameters along some decision dimension. In a more rigorous study, manipulation of parameter values in simulations will allow for the analysis of the effects of these changes on decision outcomes.

It is important for the designer to appreciate the fact that the user is a limited capacity processor. Each cognitive demand consumes part of that capacity. The less the user is occupied with the operation of the MIS or DSS, the more capacity can be devoted to performance of the task at hand. Graphics and other technologies such as voice recognition and speech generation are areas in which much work is ongoing to facilitate the user-computer dialogue. We have incorporated some of these concepts within proposed prototypes such as the SMART MAP system discussed in Stuster *et al.* (1987). However, much can be done in system design even without using higher technologies. For example, systems that provide the user with feedback concerning the status of computer operations is extremely beneficial. Systems without such feedback can cause the user to wonder whether the system is working as it should. This uncertainty can be uncomfortable and disconcerting, especially during long computer operations.

Lastly, the system developer must be prepared to listen to the user's requests. If the developer's job is done properly, the user will be making such requests based on knowledge of the anticipated scope of the project. But even if it doesn't seem to be within the project's scope, one should not overlook the Golden Rule of salesmanship, "The customer is always right." Whether or not this is true is besides the point. Both the user and the designer are better served by assuming that it is.

CONCLUSIONS

1. The user-oriented model of DSS development described in this report provides a useful framework for developing a DSS for top management at Navy bases and stations. It emphasizes the involvement of the user at all stages of development, from needs analysis to implementation and revision. The DSS development model ensures the product is user-defined, user-specified, and user-evaluated.

2. Department heads of Navy bases and stations comprise a reasonably homogeneous group of target users, who could benefit greatly from a DSS that provides generic tools usable across a wide range of managerial problems for data display, manipulation, and analysis.

3. Department heads are anxious to receive computer and decision support capabilities. They believe these capabilities will substantially improve their efficiency and effectiveness in meeting their departmental responsibilities.

4. Three patterns of information use were common among department heads: record keeping, tracking, and sleuthing. These patterns have implications for DSS tools and data retrieval methods.

5. The DSS should have as one of its goals integration with existing systems, rather than proliferation of competing systems that cannot exchange information.

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APPENDIX A

DEPARTMENT HEAD TASK ANALYSIS AND INTERVIEW

DEPARTMENT HEAD TASK ANALYSIS AND INTERVIEW

DEMOGRAPHIC DATA

Department size (total billets presently filled): ______ Military ______ Civilian

Number of people you directly supervise: ______

Average base population: ______

Your rank/grade: ______

Months/years in your department head job: ______ months ______ years

Rate your experience as a user of computer programs and applications on a scale from 0 to 4, where 0 means "inexperienced" and 4 means "very experienced." For example, a person who has never used any computer programs would rate his/her experience as 0; a person who has used several different programs extensively on several different computers would rate his/her experience as 4.

Your answer: ____

Which of the following computer programs have you personally used? (0-no; 1-yes)

- ______ Word processing
- ______ Electronic spreadsheet
- ______ Database
- ______ Communications

Do you yourself currently use a computer on the job? (0-no; 1-yes) ____

FREQUENCY AND IMPORTANCE OF MANAGEMENT TASKS

Response Scales

Frequency Scale

0	1	2	3	4	5
Never	Less than 4 times per year	Quarterly/ Bimonthly (4-10 times per year)	Monthly (1-2 times per month)	Weekly (1-3 times per week)	Daily (5+ times per week)

Importance Scale

0	1	2	3	4
Not Important		Moderately Important		Highly Important

Task Statements

Facilities Management

1. Project near- and long-term facilities/equipment requirements?
2. Plan improvement or upgrade of facilities/equipment?
3. Formulate security improvements for facilities/equipment?
4. Assess operational status of facilities/equipment?
5. Check to determine any upcoming events that require facilities/equipment from your department?
6. Schedule use of facilities/equipment?
7. Monitor use of department facilities/equipment?
8. Generate possible solutions for facilities/equipment problems?
9. Track repair of facilities/equipment?
10. Evaluate scheduling of facilities maintenance and/or construction to minimize disruption to personnel?

Personnel Management

11. Monitor current and anticipated levels of department activity to identify near- and long-term personnel requirements?
12. Set recruiting priorities to fill position openings?
13. Select prospective personnel for openings in your department?
14. Assess workload of department personnel?
15. Generate possible assignments of personnel to match workload?
16. Prepare appraisal forms for your subordinates?
17. Review results of advancement exam to assess group pass rates?
18. Identify appropriate Navy standards regarding disciplinary cases?
19. Track number of security cases, mast cases, and other disciplinary actions over time?
20. Project the training needs of your department?
21. Monitor levels of training for personnel?
22. Track personnel retention rates for department personnel?
23. Track "types of separations" for department personnel?
24. Track the general morale of department personnel?
25. Compare occupational injury and illness rates to previous rates and Navy goal?
26. Recommend changes in personnel policy related to security?
27. Validate requests for information pertaining to department personnel?

Operations Management

28. Prioritize department activities for the fiscal year?
29. Track resource requirements for department tasks?
30. Assess overall productivity of your department?
31. Set performance goals for your department?
32. Determine if existing resources are adequate for fulfilling your department's mission?
33. Develop revised policies and procedures for tasks in your department?

Operations Management (continued)

34. Set priorities for the work activities of your department?
35. Coordinate use of department resources?
36. Plan activities for which your department is responsible in anticipation of upcoming events?
37. Coordinate areas of responsibility with other department heads?
38. Determine the impact of activities of other departments on accomplishing the mission of your department?
39. Generate routine correspondence relating to the activities of your department?
40. Generate non-routine correspondence relating to the activities of your department?
41. Prepare routine department status reports?
42. Prepare non-routine reports concerning department operations?
43. Complete standard forms related to travel, training, etc.?
44. Prepare materials for briefings?
45. Monitor progress on tasks performed by your department?
46. Monitor compliance with standard operating procedures for crisis situations?
47. Schedule daily work activities in which you are involved?
48. Modify department activities based on use rates?
49. Assess processing times for products/services compared to goals?
50. Track scheduling and progress of major preventive and corrective maintenance activities?
51. Assess status of safety program?
52. Initiate corrective actions to resolve safety problems?
53. Evaluate the technical aspects of proposed contracts?
54. Carry out public relations responsibilities and activities?
55. Assess the impact of proposed actions of your department on the local community?
56. Reschedule activities to adjust for actual vs. available/projected manhour expenditures?

Financial Management

57. Develop proposed annual department budget and cost allocations?
58. Assess optimal budget allocations?
59. Provide feedback to individual section heads concerning their proposed budgets?
60. Evaluate expenditures compared to funding support?
61. Monitor expenditures of individual sections or departments?
62. Monitor expenditures in terms of regulations and legal implications?
63. Generate alternatives for absorbing budget cuts?
64. Revise the working budget for your department?
65. Redirect funds among activities of your department?
66. Identify financial irregularities in expenditures?
67. Review expenses, sales and profits of organizational units operated with nonappropriated funds?
68. Project capital investment needs?
69. Develop cost-cutting programs or action items?
70. Evaluate effectiveness of cost-cutting programs?

RESOURCE REQUIREMENTS OF MANAGEMENT TASKS

Labor Hours Question

How many hours do you personally spend on an annual basis to . . .

Task Statements

1. Project near- and long-term facilities/equipment requirements?
5. Check to determine any upcoming events that require facilities/equipment from your department?
6. Schedule use of facilities/equipment?
7. Monitor use of department facilities/equipment?
9. Track repair of facilities/equipment?
11. Monitor current and anticipated levels of department activity to identify near- and long-term personnel requirements?
16. Prepare appraisal forms for your subordinates?
19. Track number of security cases, mast cases, and other disciplinary actions over time?
20. Project the training needs of your department?
22. Track personnel retention rates for department personnel?
29. Track resource requirements for department tasks?
35. Coordinate use of department resources?
41. Prepare routine department status reports?
44. Prepare materials for briefings?
47. Schedule daily work activities in which you are involved?
57. Develop proposed annual department budget and cost allocations?
58. Assess optimal budget allocations?
60. Evaluate expenditures compared to funding support?
63. Generate alternatives for absorbing budget cuts?
66. Identify financial irregularities in expenditures?

INTERVIEW SCHEDULE

1. What measures do you use to evaluate your department's success in meeting its mission? How can performance of your department be evaluated? How do you determine your department's productivity?

2. What are the present computer capabilities of your department? What information do you most frequently request that could be incorporated in a database? What types of information do you regularly provide up the chain of command or to other departments? What types of data could you use from other departments or data bases if they were easily accessible? How frequently is the exchange of information with other departments on base required?

3. What issues are preventing or discouraging you from making greater use of management information systems that are currently available on your base/station?

4. Please provide me with a sample of the reports, figures, graphs, and tables that your department produces for recordkeeping, reporting, or presentations.

APPENDIX B

JOB TASK RATINGS

Table B - 1

TASK FREQUENCY RATINGS

Task	Administration		Civil Engineer		Comptroller		Safety		Security		Supply		Overall	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	1.93	0.96	4.07	1.27	2.71	1.44	1.94	1.29	2.62	1.50	2.60	0.84	2.62	1.42
2	1.80	1.01	3.71	1.44	2.57	1.50	1.94	1.53	2.85	1.57	2.30	1.06	2.51	1.49
3	1.20	0.94	1.93	1.27	1.36	1.01	0.75	1.13	3.15	1.34	1.90	0.74	1.66	1.32
4	2.13	1.68	3.21	1.37	2.57	1.55	2.31	1.82	3.38	1.33	3.30	1.06	2.77	1.56
5	2.53	1.51	3.29	1.07	2.93	1.44	2.56	1.31	3.38	1.71	3.30	1.34	2.96	1.41
6	3.07	1.22	2.43	1.70	2.21	1.53	2.88	1.36	2.85	1.57	2.80	1.40	2.71	1.45
7	2.73	1.33	2.86	1.51	2.86	1.70	2.88	1.67	3.69	1.44	3.10	1.73	3.00	1.55
8	2.07	1.16	4.21	0.97	3.14	1.51	3.44	1.26	3.31	1.03	3.50	1.35	3.26	1.36
9	1.67	1.29	4.29	1.14	2.64	1.55	3.19	1.47	2.77	1.42	3.70	0.95	3.00	1.55
10	1.47	1.36	3.79	1.31	1.86	1.56	1.38	1.54	1.69	1.44	2.80	1.14	2.11	1.63
11	3.00	1.07	2.36	1.28	3.14	1.03	1.88	1.75	3.08	1.19	3.30	1.34	2.74	1.37
12	2.13	1.06	1.86	1.23	1.93	0.92	1.00	0.52	1.92	1.32	2.40	1.17	1.83	1.11
13	1.73	1.10	1.57	1.16	1.43	0.65	1.06	0.68	1.69	1.11	1.80	0.92	1.52	0.96
14	3.20	1.32	2.86	1.29	3.14	1.23	3.25	1.81	3.15	1.28	3.80	1.03	3.21	1.36
15	2.93	1.49	2.86	1.51	3.14	1.17	3.31	1.89	2.92	1.61	3.50	0.97	3.10	1.47
16	2.87	1.06	1.71	0.99	1.21	0.58	1.44	1.03	1.92	1.04	2.30	0.95	1.89	1.09
17	1.33	0.82	0.57	0.65	0.43	0.85	0.25	0.58	1.00	0.71	1.10	0.74	0.76	0.81
18	1.53	0.83	1.14	1.23	1.00	0.68	0.75	0.86	1.69	1.49	2.00	1.33	1.30	1.13
19	1.40	1.40	0.50	0.65	0.36	0.50	0.75	1.53	2.23	1.64	1.20	1.23	1.05	1.36
20	2.40	0.83	1.50	0.52	2.00	1.11	2.06	1.39	2.62	1.12	2.40	0.84	2.15	1.06
21	2.27	0.88	1.36	0.50	1.79	0.70	2.31	1.30	2.92	0.76	2.20	0.63	2.13	0.97
22	1.67	1.23	0.64	0.63	0.79	0.70	0.56	1.03	2.08	1.12	1.80	1.03	1.21	1.13
23	0.87	0.64	0.50	0.52	0.64	0.50	0.19	0.40	1.38	1.04	1.20	1.03	0.76	0.79
24	4.20	1.08	2.86	1.29	2.50	1.61	3.00	2.10	3.69	1.49	3.70	1.25	3.30	1.60
25	0.73	0.46	1.14	1.17	0.86	0.66	3.00	1.03	0.92	1.19	1.10	1.10	1.34	1.25
26	2.07	1.33	0.64	0.84	0.64	0.74	0.63	1.26	2.54	1.20	1.00	0.82	1.24	1.30
27	2.80	1.57	1.14	1.29	1.07	0.47	1.19	1.52	1.92	1.38	2.20	1.40	1.70	1.45
28	2.13	0.74	2.29	1.27	2.57	0.85	2.00	0.89	2.08	1.04	2.30	0.67	2.22	0.93
29	2.13	1.25	2.86	1.17	3.21	1.25	2.00	0.82	2.54	1.33	3.20	1.03	2.61	1.21
30	3.13	0.83	3.00	0.78	2.93	0.83	2.63	1.63	3.38	1.56	3.40	1.07	3.05	1.17
31	2.13	1.13	1.71	0.91	2.29	1.14	1.88	1.31	2.92	1.38	3.00	1.05	2.27	1.23
32	2.60	1.06	2.21	1.12	2.36	1.22	2.00	1.03	3.00	1.35	2.90	0.88	2.48	1.15
33	2.40	0.91	2.07	0.62	1.57	0.94	2.13	1.26	2.31	1.11	2.90	1.10	2.20	1.05
34	3.40	1.35	3.71	0.83	3.29	0.83	3.81	1.56	3.38	1.50	3.70	1.25	3.55	1.24
35	3.07	1.62	3.50	1.45	3.07	1.14	3.50	1.46	3.46	1.39	4.10	0.88	3.41	1.37
36	3.40	1.18	3.07	1.21	3.29	1.14	2.75	1.39	3.69	0.85	4.00	0.67	3.32	1.16
37	3.93	0.80	3.86	0.86	4.00	0.78	3.56	1.31	3.69	0.95	3.90	1.29	3.82	1.00
38	3.47	1.06	3.57	1.34	3.86	1.10	3.31	1.49	3.38	1.33	3.80	1.03	3.55	1.23
39	4.33	0.72	4.14	1.17	4.43	0.76	4.88	0.34	4.54	0.66	4.60	0.52	4.49	0.76
40	3.60	1.12	3.86	1.35	3.79	0.97	4.13	1.02	3.85	0.90	4.10	1.20	3.88	1.08
41	3.13	1.60	2.71	1.44	3.07	0.92	2.63	1.31	2.62	1.61	2.90	1.66	2.84	1.40
42	2.33	1.18	2.50	1.09	2.57	0.85	2.50	1.46	3.15	1.07	2.60	1.58	2.60	1.21
43	2.67	1.45	2.07	1.07	3.36	1.50	2.25	1.00	2.38	1.04	2.00	1.05	2.48	1.26
44	2.33	1.29	2.50	1.09	2.86	0.86	3.13	0.81	3.23	1.24	2.90	0.74	2.82	1.06
45	3.87	1.30	4.36	0.74	3.50	1.16	3.44	1.15	4.15	0.69	4.30	0.95	3.90	1.07
46	2.27	1.33	2.29	1.33	1.50	1.02	2.56	1.59	3.23	1.09	3.30	1.25	2.48	1.39
47	4.00	0.93	4.50	0.94	4.07	1.14	4.00	1.46	4.00	1.08	3.90	1.29	4.09	1.14
48	2.40	1.24	2.71	1.14	2.50	1.34	2.44	1.55	2.77	1.42	3.10	0.74	2.62	1.27
49	2.20	1.37	2.14	1.29	2.50	1.56	2.00	1.63	2.54	1.33	3.10	0.57	2.37	1.37
50	1.20	1.26	3.07	1.59	1.43	1.45	2.38	1.67	2.08	1.32	2.20	0.92	2.05	1.51
51	2.00	1.51	1.64	0.84	1.64	1.28	4.44	0.89	2.15	1.28	2.40	0.84	2.43	1.52
52	1.60	0.83	2.29	0.99	1.50	1.09	4.38	0.89	2.08	1.26	2.50	0.53	2.43	1.39
53	0.87	0.74	3.29	0.99	2.29	1.59	2.06	1.24	1.00	1.15	3.20	1.62	2.06	1.52
54	2.73	1.49	2.29	1.54	2.07	1.54	2.94	1.57	2.31	1.60	2.20	1.99	2.45	1.59
55	1.67	1.35	2.36	1.34	1.50	1.56	2.00	1.75	2.46	1.66	1.90	1.79	1.98	1.56
56	2.60	1.30	3.07	0.92	2.57	1.02	2.00	1.46	2.62	1.76	3.10	0.88	2.62	1.29
57	1.47	0.74	1.43	0.76	1.79	0.97	1.44	0.73	1.62	1.04	1.60	0.84	1.55	0.83
58	1.73	1.10	2.14	0.95	3.14	1.10	1.88	1.09	1.62	0.96	2.00	0.82	2.09	1.11
59	1.20	1.01	1.93	1.38	3.36	1.28	0.44	0.81	1.69	1.44	1.90	0.99	1.71	1.46
60	2.20	1.26	2.50	0.94	3.64	1.22	2.31	1.14	2.77	1.36	2.30	1.16	2.62	1.25
61	2.47	1.30	2.29	0.99	3.93	0.92	1.38	1.59	2.23	1.59	2.80	1.03	2.48	1.48
62	2.00	1.56	2.79	1.42	4.21	0.89	1.88	1.50	2.31	1.32	3.30	1.34	2.70	1.56
63	1.53	0.64	2.00	0.88	3.21	1.19	1.44	0.89	2.00	1.22	2.20	0.92	2.04	1.12
64	1.47	0.74	1.93	0.73	2.64	0.93	1.38	0.96	1.92	1.26	1.40	0.70	1.79	0.99
65	1.20	0.68	1.86	0.77	2.79	1.25	0.88	0.96	1.46	1.39	2.10	0.74	1.67	1.17
66	1.33	1.18	2.29	1.44	3.07	1.44	1.00	1.37	1.31	1.18	2.20	1.40	1.83	1.49
67	0.33	0.62	0.14	0.36	2.07	1.33	0.06	0.25	0.38	0.96	1.40	1.65	0.68	1.17
68	0.73	0.70	1.71	1.07	1.29	0.73	0.50	0.73	0.85	1.14	1.20	0.79	1.02	0.94
69	1.27	0.80	2.29	1.49	2.50	0.85	1.25	1.44	1.31	1.25	2.20	0.79	1.77	1.25
70	1.33	0.98	2.00	1.24	2.00	0.88	1.25	1.48	1.38	1.12	2.00	0.82	1.63	1.15

Table B - 2

TASK IMPORTANCE RATINGS

Task	Administration		Civil Engineer		Comptroller		Safety		Security		Supply		Overall	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	3.07	0.80	3.86	0.36	3.07	0.83	2.75	1.24	3.31	1.11	2.70	1.06	3.13	0.99
2	3.07	0.80	3.79	0.58	3.21	0.89	2.63	1.54	3.08	1.19	3.20	1.14	3.15	1.10
3	2.87	1.51	2.00	1.24	2.29	1.59	1.00	1.59	3.69	0.48	2.50	1.35	2.34	1.57
4	2.67	1.40	3.43	0.85	3.14	0.95	2.38	1.67	3.23	0.83	3.00	0.94	2.95	1.21
5	3.07	0.88	3.14	0.95	2.93	0.83	3.06	1.18	3.08	1.19	3.00	0.82	3.05	0.97
6	2.80	0.94	2.21	1.53	1.93	1.44	2.63	1.09	2.62	1.19	3.10	0.74	2.52	1.22
7	2.47	1.19	2.64	1.22	2.07	1.38	2.56	1.09	2.69	0.75	2.80	1.14	2.52	1.14
8	2.73	1.10	3.71	0.47	3.00	0.88	3.44	0.81	3.23	0.83	3.70	0.48	3.28	0.86
9	2.33	1.40	3.71	0.61	2.21	0.97	3.13	1.02	2.92	1.12	3.10	0.99	2.89	1.14
10	2.27	1.71	3.57	0.65	1.79	1.42	1.69	1.62	2.00	1.53	2.70	0.95	2.30	1.50
11	3.53	0.83	2.86	1.29	3.36	0.63	2.88	1.63	3.15	1.14	3.10	1.10	3.15	1.16
12	2.87	1.36	2.36	1.50	3.50	0.85	2.88	1.45	2.62	1.39	2.80	1.23	2.84	1.33
13	3.53	1.13	2.57	1.34	3.71	0.83	3.06	1.48	2.85	1.57	2.80	1.14	3.11	1.31
14	3.40	0.74	3.14	1.03	2.71	1.07	3.06	1.39	2.77	1.17	3.50	0.53	3.09	1.06
15	3.13	0.83	3.00	1.30	2.86	0.77	2.81	1.47	2.92	1.12	2.90	0.88	2.94	1.08
16	3.93	0.26	2.71	1.33	2.93	0.92	2.88	1.41	3.08	1.32	3.70	0.67	3.18	1.15
17	2.67	1.45	0.86	1.17	0.43	0.85	0.56	1.36	2.08	1.50	2.10	1.60	1.40	1.56
18	2.67	1.35	1.00	1.11	1.14	1.17	1.56	1.82	2.31	1.44	2.50	1.51	1.83	1.53
19	1.60	1.59	0.64	0.93	0.43	0.76	0.69	1.40	2.08	1.26	1.80	1.93	1.16	1.44
20	3.20	0.77	2.50	1.02	2.57	0.76	3.13	1.36	3.23	1.17	3.40	0.70	2.99	1.04
21	3.20	0.77	2.29	0.99	2.29	0.83	3.19	1.11	3.38	0.77	3.20	0.79	2.91	0.98
22	2.27	1.44	0.86	1.03	1.43	1.34	1.06	1.69	2.15	1.14	2.50	1.18	1.66	1.44
23	1.47	1.30	0.86	1.03	1.00	1.24	0.44	0.96	1.54	1.27	1.40	1.35	1.09	1.22
24	3.93	0.26	3.00	1.24	2.79	1.58	2.88	1.75	3.15	1.46	3.60	0.52	3.21	1.32
25	1.67	1.29	1.14	1.17	1.00	0.78	3.69	0.70	1.38	1.39	1.60	1.65	1.80	1.49
26	3.27	1.16	0.64	0.84	0.93	1.21	1.00	1.46	3.23	0.73	1.60	1.58	1.77	1.60
27	3.20	1.15	1.57	1.34	2.14	1.03	1.38	1.75	2.00	1.35	2.80	1.03	2.15	1.44
28	3.13	0.99	3.29	0.91	3.43	0.65	3.06	1.18	3.00	1.15	3.40	0.84	3.21	0.97
29	2.73	1.33	3.14	1.10	3.50	0.65	2.81	1.17	2.77	1.01	3.40	0.70	3.04	1.06
30	3.33	0.82	3.14	0.86	3.50	0.85	2.94	1.34	3.15	1.14	3.60	0.52	3.26	0.98
31	3.27	1.16	3.29	1.20	3.57	0.85	3.50	0.73	3.46	1.13	3.80	0.42	3.46	0.96
32	3.33	0.72	3.43	1.16	3.64	0.50	3.31	0.79	3.46	1.13	4.00	0.00	3.50	0.84
33	2.93	0.80	3.21	0.70	2.64	0.84	3.31	1.20	3.00	1.00	2.70	1.06	2.99	0.95
34	3.27	0.80	3.36	0.63	3.36	0.63	3.56	1.03	3.15	1.28	3.30	0.67	3.34	0.86
35	3.07	1.10	3.07	1.07	3.07	1.00	3.13	1.02	3.08	1.26	3.50	0.71	3.13	1.03
36	3.40	0.63	2.86	1.23	3.21	0.97	3.50	1.10	3.38	0.65	3.00	1.15	3.24	0.98
37	3.47	0.74	3.57	0.65	3.43	0.51	3.75	0.58	3.62	0.51	3.20	1.03	3.52	0.67
38	3.33	0.72	3.50	0.65	3.57	0.51	3.19	1.17	3.46	0.52	3.40	0.84	3.40	0.77
39	2.73	0.96	2.29	0.99	2.93	0.73	3.13	0.89	3.00	0.71	2.80	0.92	2.82	0.89
40	2.87	0.99	3.00	0.68	3.14	0.77	3.38	1.09	3.15	0.90	2.60	0.97	3.05	0.91
41	2.07	1.22	1.86	1.23	2.50	0.85	2.56	1.09	1.77	0.83	2.30	1.34	2.18	1.11
42	2.53	1.25	2.43	1.02	2.93	0.73	2.69	1.25	2.46	0.88	2.30	1.25	2.57	1.07
43	2.53	1.19	1.29	0.99	2.64	1.01	2.69	1.14	1.85	0.80	2.10	1.37	2.21	1.17
44	3.07	1.03	2.93	0.83	3.14	0.95	3.63	0.50	2.92	0.95	2.80	0.92	3.11	0.89
45	3.27	0.80	3.14	0.95	3.36	0.84	3.56	0.73	3.62	0.51	3.80	0.42	3.44	0.76
46	2.87	0.99	2.50	1.29	2.43	1.50	3.50	1.03	4.00	0.00	3.20	1.48	3.07	1.25
47	3.07	0.70	3.14	0.86	3.21	1.12	3.50	0.89	3.31	0.75	3.30	0.67	3.26	0.84
48	2.67	0.98	2.50	1.02	2.14	0.95	2.69	1.25	2.69	1.11	2.50	0.71	2.54	1.02
49	2.60	1.06	2.43	1.22	2.43	1.50	2.31	1.30	2.46	1.20	3.40	0.70	2.56	1.22
50	1.60	1.50	3.00	1.47	1.57	1.60	2.56	1.71	1.62	1.04	2.30	1.06	2.11	1.52
51	2.13	1.46	1.64	1.01	1.64	1.28	3.94	0.25	2.38	1.26	2.50	1.43	2.40	1.40
52	2.93	1.10	2.14	1.23	2.43	1.45	3.81	0.54	2.85	1.46	3.10	1.10	2.89	1.27
53	1.27	1.44	3.21	0.80	2.29	1.33	2.50	1.26	1.77	1.59	3.40	1.07	2.35	1.44
54	3.13	1.13	2.29	1.49	2.29	1.59	3.25	1.34	3.08	1.19	2.10	1.37	2.73	1.40
55	2.80	1.66	2.21	1.19	1.79	1.42	2.75	1.69	3.31	1.11	1.70	1.34	2.46	1.50
56	2.80	0.94	2.57	1.09	2.93	0.92	2.19	1.42	2.62	1.33	2.70	0.67	2.62	1.11
57	2.80	1.21	3.29	1.27	4.00	0.00	3.06	1.12	3.08	1.19	2.50	1.43	3.15	1.18
58	2.60	1.35	3.21	0.97	4.00	0.00	2.88	1.31	2.85	1.21	3.00	0.94	3.09	1.15
59	2.13	1.55	2.64	1.55	3.79	0.58	0.63	1.26	2.54	1.61	2.80	1.14	2.35	1.64
60	2.93	1.33	3.14	1.29	3.93	0.27	2.88	1.45	3.00	1.15	2.60	1.26	3.10	1.23
61	2.40	1.45	2.79	1.31	3.64	0.63	1.13	1.59	2.38	1.50	2.60	1.26	2.45	1.52
62	2.60	1.50	3.07	0.92	3.93	0.27	2.19	1.68	3.00	1.22	3.50	0.71	3.00	1.30
63	3.07	0.88	2.79	0.80	3.93	0.27	2.44	1.55	2.69	1.25	3.00	0.94	2.98	1.12
64	2.53	1.13	2.64	1.01	3.57	0.65	2.56	1.59	2.62	1.04	2.10	1.20	2.70	1.19
65	2.27	1.33	2.50	1.34	3.50	0.76	1.44	1.59	1.85	1.41	2.50	0.85	2.32	1.40
66	2.47	1.68	2.86	1.23	3.86	0.36	1.44	1.82	2.08	1.71	3.00	1.49	2.57	1.63
67	0.40	0.74	0.36	1.08	2.07	1.33	0.00	0.00	0.38	0.96	1.60	1.65	0.74	1.26
68	1.53	1.60	2.79	1.05	2.79	1.12	1.13	1.67	1.54	1.66	1.90	1.45	1.93	1.55
69	2.40	1.30	2.64	1.15	3.79	0.58	2.00	1.83	2.38	1.33	3.00	1.15	2.67	1.39
70	2.53	1.30	2.64	1.08	3.71	0.61	1.81	1.83	2.23	1.24	2.90	1.20	2.61	1.39

APPENDIX C

MEASURES OF ASSOCIATION BETWEEN TASK RANKINGS

Table C - 1

AGREEMENT BETWEEN PAIRED DEPARTMENTS ON RANK-ORDERING OF TASKS BY FREQUENCY

	Administration		Civil Engineer		Comptroller		Safety		Security		Supply	
	Tau*	Z**	Tau	Z	Tau	Z	Tau	Z	Tau	Z	Tau	Z
Civil Engineer	0.39	4.8										
Comptroller	0.38	4.7	0.51	6.2								
Safety	0.53	6.5	0.53	6.5	0.35	4.3						
Security	0.64	7.8	0.50	6.1	0.39	4.7	0.56	6.9				
Supply	0.57	7.0	0.65	7.9	0.51	6.3	0.60	7.3	0.63	7.7		
Overall	0.64	7.8	0.70	8.6	0.60	7.3	0.70	8.6	0.71	8.7	0.78	9.6

* Kendall's Tau, a nonparametric test of statistical association.
** Z-score transformation of Kendall's Tau to allow interpretation as a normal distribution.

Table C - 2

AGREEMENT BETWEEN PAIRED DEPARTMENTS ON RANK-ORDERING OF TASKS BY IMPORTANCE

	Administration		Civil Engineer		Comptroller		Safety		Security		Supply	
	Tau*	Z**	Tau	Z	Tau	Z	Tau	Z	Tau	Z	Tau	Z
Civil Engineer	0.24	2.9										
Comptroller	0.21	2.6	0.40	4.9								
Safety	0.41	5.0	0.30	3.7	0.14	1.7						
Security	0.60	7.4	0.36	4.4	0.21	2.6	0.47	5.8				
Supply	0.43	5.3	0.45	5.5	0.32	3.9	0.33	4.1	0.42	5.2		
Overall	0.59	7.2	0.58	7.1	0.48	5.9	0.55	6.7	0.64	7.8	0.58	7.1

* Kendall's Tau, a nonparametric test of statistical association.
** Z-score transformation of Kendall's Tau to allow interpretation as a normal distribution.

Table C - 3

AGREEMENT AMONG DEPARTMENT HEADS ON RANK-ORDERING
OF TASKS BY FREQUENCY AND IMPORTANCE

	Administration		Civil Engineer		Comptroller		Safety		Security		Supply	
	Tau*	Z**	Tau	Z	Tau	Z	Tau	Z	Tau	Z	Tau	Z
Department	0.50	6.2	0.54	6.6	0.46	5.6	0.62	7.6	0.54	6.6	0.51	6.3
										Overall	0.49	6.0

* Kendall's Tau, a nonparametric test of statistical association.
** Z-score transformation of Kendall's Tau to allow interpretation as a normal distribution.

Table C - 4

AGREEMENT AMONG DEPARTMENT HEADS AT VARIOUS TYPES OF COMMANDS ON RANK-ORDERING OF TASKS BY FREQUENCY

	Naval Stations		Naval Air Stations	
	Tau*	Z**	Tau	Z
Naval Air Stations	0.79	9.7		
Other Bases/Stations	0.83	10.2	0.79	9.6

* Kendall's Tau, a nonparametric test of statistical association.
** Z-score transformation of Kendall's Tau to allow interpretation as a normal distribution.

Table C - 5

AGREEMENT AMONG DEPARTMENT HEADS AT VARIOUS TYPES OF COMMANDS ON RANK-ORDERING OF TASKS BY IMPORTANCE

	Naval Stations		Naval Air Stations	
	Tau*	Z**	Tau	Z
Naval Air Stations	0.74	9.0		
Other Bases/Stations	0.58	7.2	0.61	7.4

* Kendall's Tau, a nonparametric test of statistical association.
** Z-score transformation of Kendall's Tau to allow interpretation as a normal distribution.

APPENDIX D

COMPUTER SUPPORT NEEDS REPORTED BY DEPARTMENT HEADS

COMPUTER SUPPORT NEEDS REPORTED BY DEPARTMENT HEADS

The following information was compiled from comments made by department heads during the interviews. The list identifies areas where computer and decision support is needed by base and station department heads.

Administration

- o Tracking correspondence throughout command
- o Maintaining and revising instructions, notices
- o Maintaining manning and personnel data:
  - manning requirements
  - retention rates
  - security clearances
  - status of personnel advances
  - personnel location on base
  - personnel medical status
- o Sharing of personnel data with appropriate departments
- o Method to tally information automatically
- o Statistical analysis tools
- o Electronic mail

Civil Engineering/Public Works

- o Tracking building and maintenance projects
- o Timely access to job status information
- o Network with supply MIS information
- o Real-time financial status information
- o Automation of blueprints, digitized floor plans, work orders
- o Assistance in prioritizing projects
- o Improved quality of annual inspection summary report

Comptroller

- o Timely and accurate data concerning budget execution
- o Ability to respond to larger number of budget requests
- o Ability to respond to larger number of ADP equipment requests
- o Need for MIS interface between comptroller and supply
- o More timely and accurate requisition status information
- o Timely data to calculate operating targets (OPTARS)
- o Graphics capabilities

Safety

- o More timely, accurate injury data
- o Ability to link with supply, personnel data
- o Track progress on OSHA-mandated safety tasks
- o Improve monitoring of hazardous materials
- o Respond faster to inspection data requests
- o Monitor larger number of incident reports
- o Track, retrieve, summarize many kinds of data:
  - training rosters
  - mishap vehicle reports
  - deficiency notices
  - hazards communication log
  - log of occupational illness/injury

Security

- o Tracking base entry security information
- o Tracking base security force training, qualifications
- o Monitoring of criminal activity on base by location, suspects
- o Tracking additional security information:
  - prior security violations
  - DWI violations
  - base-barred drivers
  - security force information
  - security qualifications training
- o Monitor and easily retrieve many kinds of security information:
  - criminal activity file
  - suspect file
  - on-base weapons file
  - traffic violation file
- o Statistical analysis capabilities to answer questions concerning base security, such as:
  - How do shifts in the location of security personnel affect incidence frequency?
  - What is the pattern of incidents throughout the year?
- o Network with administration, supply, safety
- o Network with other bases on security information
- o Standard formats for incidents reports (in order to force common structure, encourage complete reporting)

Supply

- o Automated procurement process
- o Network with comptroller
- o Fast and easy connection with larger automated systems
- o Tracking of requisitions
- o Maintaining computerized inventory of supply line items
- o Tracking supply inventory location
- o Tools to assist in optimizing warehouse space

APPENDIX E

MIS EVALUATION INDICATORS REPORTED BY DEPARTMENT HEADS

MIS EVALUATION INDICATORS REPORTED BY DEPARTMENT HEADS

The following information lists department-specific evaluation indicators that could be used to assess the implementation and effectiveness of computer support systems.

Administration

Indicators given a high priority by a majority of administration department heads concerned feedback from superiors and, to a lesser degree, work quality, speed, and timeliness. Those specifically mentioned included:

- o Speed and timeliness in preparation of reports, briefing materials, decision papers, and training materials.
- o Accuracy of data provided to decision makers.
- o Ease of access to and availability of information.
- o Elimination of double entry and file storage of data.
- o Improved response time for command correspondence (increased timeliness) and status reports.
- o Quality of work output, such as reduction in number of errors in routine reports and internal/external correspondence, and consequent reduction in number of times work is redone.
- o Overall quality of format and content of reports, briefing materials, and other documents.
- o Meaningfulness, completeness, and usefulness of data or information available.
- o Reduction in number of user or client complaints.
- o Extent to which department members are available to work directly towards achieving department needs and command mission in a cost-effective manner.

Comptroller

Performance indicators most frequently discussed generally referred to accuracy and timeliness of budgets and degree of compliance with budget targets. Specifically mentioned were:

- o Overspending versus underspending.
- o Extent of satisfaction/dissatisfaction expressed by other department heads (DHs).
- o Extent of concern expressed by CO.
- o Retention of personnel.
- o Extent of cost saving actions by other DHs.
- o Reduction in need for labor hours spent in rechecking and reentering financial and budgetary data.
- o Capacity to store and analyze financial investigative data.
- o Clarity, timeliness, and meaningfulness of budgetary data presented to CO/XO/DHs.
- o Number of report deadlines met.
- o Speed of access to status of requisition requests.
- o Flexibility and responsiveness to changes in funds available or unexpected nonbudgeted requirements.

- o Timeliness and status of host-tenant agreements.
- o Feedback from client DHs or tenant commands.
- o Speed and accuracy in recognizing trends.
- o Number of labor hours spent on routine reports and correspondence.
- o Total bottom line costs of typical base/installation jobs.
- o Speed and accuracy of procurement actions.
- o Extent of compliance with regulations and statutes.

Civil Engineering/Public Works

Most frequently indicated measures of department performance and useful measures of an MIS related to customer satisfaction or feedback, or timeliness of work performed. Specific indices included:

- o Timeliness of completed tasks.
- o Extent to which procedural improvements led to benefits exceeding costs.
- o Timeliness of response to customer requests.
- o Number of work area inspections completed in a given period.
- o Turnaround time, amount of lost time, scheduling time, resheduling flexibility.
- o Number of jobs completed.
- o Number of jobs backlogged.
- o Average period of time from receipt of request to final signoff and replenishment of parts and materials used.
- o Timeliness and ease of initiating, logging, and assigning work orders.
- o Number of lapsed contracts.
- o Number of letters of appreciation and complaints.
- o Housing occupancy rates.
- o Availibility of base transportation and percentage of downtime of base vehicles.
- o Percentage of downtime of maintenance and other equipment.
- o Extent of compliance with OPTARS.
- o Accuracy and timeliness of data available and used.
- o Clarity, feasibility, appropriateness, and comprehensiveness of department plan for completing its mission.

Safety

Most frequently identifed indicators of department performance were ratio of labor hours devoted to field inspections versus office-based activities/paperwork, timeliness of response to inspection requests, number and thoroughness of inspections, and number of critical incidents or accidents. Department heads noted that superior performance by the department may have practical, beneficial consequences that do not become manifest until many months or years later. Other performance measures mentioned included:

- o Feedback from other departments.
- o Extent of compliance with safety standards.
- o OSHA reports and inspection results.
- o Number of discrepancies identified and abated.
- o Timeliness and accuracy of inspection reports.
- o Number of labor hours lost to accidents.
- o Dollars spent on workers' compensation and disability claims.
- o Increased amount of useful, accurate, relevant data.

Security

Most frequently discussed performance measures stressed feedback from other departments, timeliness in responding to emergency calls, and productivity, as indicated by numbers of contacts or incidents dealt with per shift. Other indicators identified included:

- o Number of complaints.
- o Courtroom success rate.
- o Responsiveness to requests for information.
- o Number of reports received and investigated.
- o Number and seriousness of illegal incidents on base.
- o Time available for field police functions.
- o Accuracy and completeness of incident and investigative reports.

Supply

Most frequently discussed performance measures related to timeliness of response, customer feedback, plus the number, speed and accuracy of requisition requests successfully processed. Other indicators included:

- o Extent of data entry duplication.
- o Number of customer complaints.
- o Accuracy of inventory data.
- o Amount of compliance monitoring.
- o Accuracy in identifying ordering trends.
- o Extent of backlogged orders.

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